Vol. 12, No. 97.] JANUARY, 1910. [Price SIXPENCE Net.

FOUNDRY TRADE JOURNAL

AND PATTERN-MAKER

EDITORIAL & ADVERTISEMENT OFFICES:
168, Strand, London, W.C.

COMPLETE SAND BLAST APPARATUS

For Cleaning large and small Castings.

WILL SAVE 50 % IN FETTLERS' WAGES.

IN USE BY THE FOLLOWING WELL-KNOWN FIRMS—

Name.	Address.	Name.	Address.
Beardmore, W. & Co., Ltd.	Glasgow.	H.M. Dockyards	Sheerness.
Bradfields Steel Foundry Co., Ltd.	Sheffield.	H.M. Dockyards	Chatham.
Vickers, Sons & Maxim, Ltd.	Barrow.	H.M. Dockyards	Portsmouth.
Darlington Forge Co., Ltd.	Darlington.	Clarke, Chapman & Co., Ltd.	Gateshead.
Coltness Iron Co., Ltd.	Lanark.	Shanks & Co.	Barrhead.
Dickson & Mann, Ltd.	Armadale, N.B.	Dobson & Barlow, Ltd.	Bolton.
Osborn, S. & Co., Ltd.	Sheffield.	Maddocks, J. & Co.	Oakengates.
Steel Company of Scotland, Ltd.	Glasgow.	Russell, S. & Co., Ltd.	Walsall.
Jackson, T. R. & Co., Ltd.	Manchester	Haden, G. N. & Sons	Trowbridge.
Crowley, John & Co., Ltd.	Sheffield.	Ballis & Morcom, Ltd.	Birmingham.
Ley's Malleable Castings Co., Ltd.	Derby.	Clayton & Shuttleworth, Ltd.	Lincoln.
Marshall, Sons & Co., Ltd.	Gainsborough.	Macfarlane Bros.	Glasgow.
Ruston, Proctor & Co., Ltd.	Lincoln.	British Insulated & Helsby Cables, Ltd.	Prescot.
Tweedales & Smalley	Castleton.		
H.M. Dockyards	Devonport.		

AIR COMPRESSORS driven by Steam, Belt or Electrically.

CATALOGUES FREE ON APPLICATION.

TILGHMAN'S PATENT SAND BLAST CO., LTD.,

BROADHEATH, nr. Manchester.

WE SUPPLY **THE** LEADING FIRMS IN THE TRADE WITH

FOUNDRY BLACKINGS

OF ALL KINDS,

COAL DUST, CHARCOAL, PLUMBAGO and BLACK-LEAD, CORE GUMS and all Foundry Requisites, and have been so since 1821.

I. & I. WALKER, EFFINGHAM MILLS, ROTHERHAM.

Our Specialite is Studying Special Requirements.
KINDLY HAND US YOUR ENQUIRIES.

T. & I. BRADLEY & SONS, LTD.,

COLD BLAST PIG IRON

PIG IRON BRANDS

PART MINE. WARM AND COLD BLAST. IXL. ALL MINE. A M

THE GUARANTEED ANALYSIS.

DARLASTON BLAST FURNACES,

DARLASTON, SOUTH STAFFS.

Index to Advertisers.

Addresses, Telegraphic Addresses, and Telephone Numbers.

PAGE NO.	NAME.	DESCRIPTION.	ADDRESS.	TELEGRAPHIC ADDRESS.	TELEPHONE NO.
4	Alldays & Onions, Ltd.	Foundry Plant	Birmingham	Alldays, Birmingham	328 Victoria
C. ii.	Bradley, T. & I., & Sons, Ltd.	Pig-Iron	Darlaston	—	—
C. iii.	Buffalo Forge Co.	Fans and Blowers	Caxton House, London	Buffaloes, London	Victoria 420.
5	Bush, Henry C.	Foundry Specialists	The Strand, Derby	Bushes, Derby	Nat. Tel. 143 & 387.
54	Cumming, William, & Co., Ltd.	Blacking Manufacturers	Maryhill, Glasgow	Prudence, Glasgow	P.O. M. 25
3	Davies, T., & Sons	Cupolas	West Gorton, Manchester	Tuyere, Manchester	70 Openshaw
51	Durrant, Jas., & Sons	Foundry Equipment	Penistone, nr. Sheffield	Durrans, Penistone	—
2	Dyson, J. & J.	Ground Gannister	Sheffield	Dyson's, Stannington	702 Sheffield
49	Elders' Navigation Collieries Ltd.	Foundry Coke	Cardiff	Elder, Maesteg	10
8 & 47	Evans, J., & Co.	Foundry Requisites	Manchester	Ladles, Manchester	2297
5	Frodair Iron & Steel Co., Ltd.	Pig-Iron	5, Fenchurch Street, E.C.	Frodair, London	—
55	Griffin, Chas., & Co., Ltd.	Publications	Exeter Street, Strand, W.C.	—	—
6	Hall, Charles & Co.	Foundry Requisites	Dantzic Street, Manchester	—	—
1	Harris & Pearson	Cupola Linings	Stourbridge	Fireclay, Stourbridge	7 Brierley Hill
2	Hislop, R. & G.	Gas Engineers	Paisley	Gas, Paisley	321 Paisley
C. iv.	Jackman, J. W., & Co.	Foundry Requisites	Caxton House, S.W.	Molders, London	30 Victoria
—	Jenkins, W. J., & Co.	Gas Cleaning Fans	Retford	—	—
2	King, Bros.	Cupola Bricks	Stourbridge	—	—
52	London Emery Works Co., Ltd.	Foundry Requisites	Park, Tottenham	Naxium, London	99 Tottenham
48	Lowood, J. Grayson, & Co., Ltd.	Ganister, Cupola Blocks, &c.	Deepcar, nr. Sheffield	Lowood, nr. Sheffield	18 Stocksbridge
5	Marshall, H. P., & Co.	Core Machines	Leeds	Specialty, Leeds	1909 Leeds
55	McNeil, Chas.	Steel Ladles	Kinning Park, Glasgow	McNeil, Glasgow	X 155
55	Olsen, William	Plumbago and Blacking	Cogan Street, Hull	—	—
6	Phillips, Chas. D.	Foundry Core Ovens	Newport, Monmouthshire	Machinery, Newport	18 & P.O. 576
6	Phillips, J. W. & C. J.	Foundry Requisites	23, College Hill, E.C.	Colloquial, London	10122 Central
C. iii.	Plasti-Kion Co., The	Iron Cement	Caxton House, S.W.	—	—
50	Pneumatic Eng. Appliances Co., Ltd.	Pneumatic Appliances	Palace Chambers, Westmntr. S.W.	Pneumogram, London	856 P.O. Victoria
—	Proctor, Bowes & Co.	Straw Ropes	Newcastle-on-Tyne	Proctor Bowes, Newcastle-on-Tyne	Nat. 1683 Centr'l
—	Samuelson & Co., Ltd.	Blowers	Banbury	Samuelson, Banbury	—
—	Selig, Sonnenthal & Co.	Foundry Separator	85, Queen Victoria Street, E.C.	Selig, London	341 Bank
—	Silent Machine & Engineering Co.	Foundry Cement	2, Savile Street, Sheffield	Forward, Sheffield	189, 1472, &c.
—	Silica Firebrick Co.	Ground Ganister	Oughtibridge	Silica Co., Oughtibridge	—
6	Stonehouse Works Co.	Wood, Wool, Core Ropes	King Edward's Rd., Birmingham	Tailboard, Birmingham	3069 Cl. (3 lines)
—	Swift, James, & Son	Microscopes	81, Tottenham Court Rd., London	Prisms, London	—
49	Thermit, Ltd.	Welding	27, Martin's Lane, E.C.	Fulmen, London	3749 Central
C. ii	Tilghman's Patent Sand Blast Co., Ltd.	Sand Blast Apparatus	Broadheath, nr. Manchester	Tilghmans, Altrincham	14
7	Thwaites Bros., Ltd.	Foundry Plant	Bradford	Thwaites, Bradford	325 Bradford
4	Vaughan & Sons, Ltd.	Cranes	West Gorton, Manchester	—	—
C. ii.	Walker, I. & I.	Foundry Blackings	Rotherham	—	—
—	Ward, T. W., Ltd.	Cupolas, Loam Mills, &c.	Albion Works, Sheffield	Forward, Sheffield	189, 1472, &c.
2	Whittaker, W., & Sons, Ltd.	Moulding Machines	Oldham	—	—
5	Wilkinson, Thos., & Co., Ltd.	Foundry Requisites	Middlesbrough	Blacking, Middlesbro'	419

STOURBRIDGE FIRE BRICKS

Of Best Quality for Lining Cupolas in Stock,

ALSO MADE TO ANY DESIGN.

Linings Stocked to Customers' Plans to ensure IMMEDIATE DELIVERY.

All kinds of Fireclay Goods of Highest Quality.

HARRIS & PEARSON, STOURBRIDGE.

Telegrams:—"FIRECLAY, STOURBRIDGE." Telephone:—No. 7 Brierley Hill.

FIRE BRICKS & CLAY

CUPOLA BRICKS.

BEST QUALITY.

LESSEES OF DELPH AND TINTERN ABBEY BLACK AND WHITE CLAY.

KING BROTHERS,
(STOURBRIDGE) Ltd.,
STOURBRIDGE.

EFFICIENT and ECONOMICAL HEATING
OF
STOVES,
ANNEALING OVENS,
FURNACES, Etc.

R. & G. HISLOP,
GAS ENGINEERS,
UNDERWOOD HOUSE, PAISLEY.

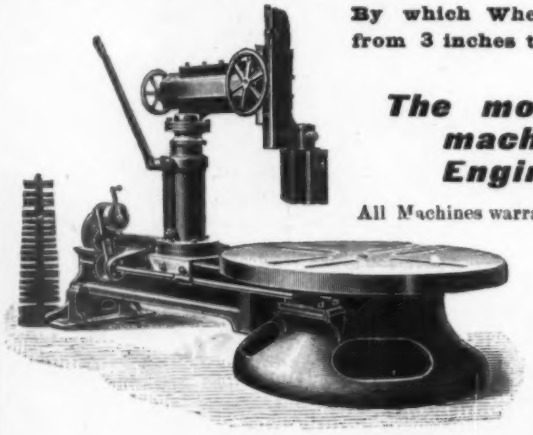
Sole Makers of **"PEHRSON'S PATENT STEEL MOULDERS' GREENSAND."**

GROUND GANNISTER, STEEL MOULDERS' COMPOSITIONS, SILICA CEMENT.

Gannister Bricks, Fire Bricks, Stoppers and Nozzles. Crucible Clay for all Purposes.

J. & J. DYSON, SHEFFIELD GANNISTER WORKS, ATTERCLIFFE ROAD, SHEFFIELD.
Telegrams—"DYSON'S, STANNINGTON." Telephone—No. 702 SHEFFIELD.

WHITTAKER'S IMPROVED MOULDING MACHINE



By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 ft. diameter can be made.

The most complete and efficient machine hitherto introduced to Engineers.

All Machines warranted to Mould with the greatest accuracy and precision.

GEARING WHEELS
Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.

ROPE & BELT PULLEYS.

WM. WHITTAKER & SONS, LTD.,
SUN IRON WORKS, *OLDHAM.*

T. DAVIES & SON,

RAILWAY IRON WORKS, WEST GORTON, MANCHESTER.

ON ADMIRALTY LIST.

Telegrams—"TUYERE, MANCHESTER." Nat. Telephone—No. 70, OPENSHAW.

MAKERS OF

Foundry Cupolas and Ladles.

CHARGING PLATFORMS, HOISTS, FOUNDRY RATTLERS, CORE STOVE DOORS, ROOTS' BLOWERS.

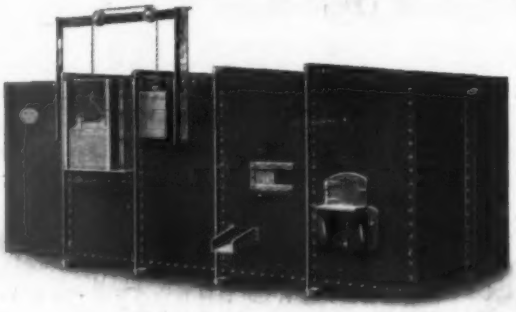
STANDARD SIZES IN STOCK OR PROGRESS.

LICENSEES AND MAKERS OF

Osborn's Patent Spark Arrester.

A 2

FOUNDRY PLANT.



Empire Air Furnace,
FOR MELTING BRASS, GUNMETAL, CAST IRON, &c.

"RAPID" CUPOLAS.

"Climax" Roots' Blowers.

FANS. CORE OVENS.

MOULDERS' TOOLS AND BELLOWS.

EMPIRE OIL-FIRED ROLLING FURNACE.

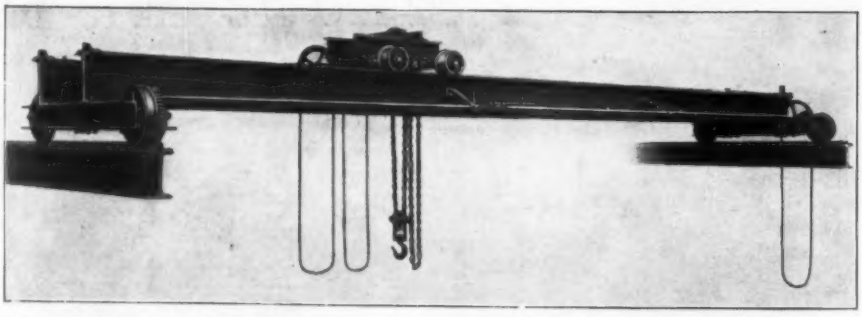
LADLES, &c.

ALLDAYS & ONIONS, Pneumatic Engineering **Co., Ltd.,**

B Dept.,
Great Western Works,
BIRMINGHAM.

And at
58 Holborn Viaduct,
LONDON, E.C.

VAUGHAN'S OVERHEAD TRAVELLING CRANES.



HAND POWER or ELECTRIC.

SPECIALLY DESIGNED FOR FOUNDRY WORK.

FOR LIGHT OR HEAVY LOADS.

VAUGHAN & SON, LTD.,
CRANE BUILDERS.

WEST GORTON-W.
MANCHESTER.

FOUNDRY REQUISITES of Every Description

In Stock for Prompt Delivery.

PIG IRON, FOUNDRY COKE, GANISTER, LIMESTONE, SAND, ETC.

Also Manufacturer of WOOD WOOL CORE ROPE

Which is far superior to Straw Rope, and other similar material on the market. Sizes ¼ in. to 2 in. diameter in stock.

Prices and Samples on Application.

HENRY C. BUSH, COMPLETE FOUNDRY SUPPLIER, DERBY.

Tel: 143 & 387. Tele: Bushes, Derby.

IMPROVED CORE MACHINES.

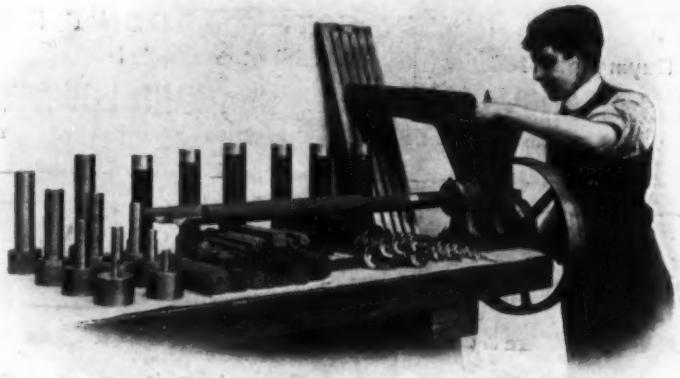
Capacities, 3/8 in. to 6 in.

ROTARY TYPE:—
Two feet of perfect core in 10 seconds.
Improved worms.
Cheap mixtures.
Excellent results.

PISTON TYPE:—
Recommended for large sizes.
Ordinary sand.
Dead length.

Round, square, oval, oblong and other sections on either machine.

Further particulars on application.



Adopted by British Admiralty, Railway Companies and others throughout the country and abroad.

HORACE P. MARSHALL & CO., LEEDS

ON ADMIRALTY, WAR OFFICE, and INDIAN OFFICE LISTS.

COAL DUST.

A good Coal Dust is worth a good price, because it saves labour and gives a good appearance to the Castings. Our Coal Dust is made from Best Durham Coal, and is screened into several different sizes to suit different kinds of work—from finest flour for light work to pin-head size for heavy work.

We send it to all parts of the country. The quality and grading are so good that high railway rates to distant places do not put us out of count.

Send for Free Trial Sample and Price,

THOMAS WILKINSON & CO., LTD., FOUNDRY STORES, MIDDLESBROUGH.

CHARLES D. PHILLIPS'

THE ORIGINAL FIRM
— Established 1867. —

Registered and Improved
No. 356,812

FOUNDRY CORE OVEN

built in wall.

Head Office—
EMLYN WORKS, NEWPORT, MON.
(And Gloucester).

ESTABLISHED 42 YEARS.

CHAS. HALL & CO.,

FOUNDRY REQUISITE MAKER,

DANTZIC ST., MANCHESTER.
TELEPHONE No. 5814, CITY.

STEEL WIRE BRUSHES.

Chaplets and Studs a Speciality.

WOOD WOOL CORE ROPES,

WE ARE

ACTUAL MANUFACTURERS (NOT FACTORS),

Of all Sizes ¼ to 2½.

BUY DIRECT. DON'T BE MISLED.

Buying per 1000 yards, you cannot measure it. . . . Buy by guaranteed weight.

FROM STONEHOUSE WORKS, CO., KING EDWARD'S ROAD, BIRMINGHAM.

TELEPHONE: No. 3069, "CENTRAL 3-LINES" WORKS: "PERRY BAR." TELEPHONE: 237 EAST. TELEGRAMS: "TAILBOARD, BIRMINGHAM."

WE PUBLISH THE MOST COMPLETE CATALOGUE OF

MODERN FOUNDRY EQUIPMENT.

For 27 years our name has been a guarantee of quality.

WRITE FOR NEW LISTS SINCE PUBLISHED.

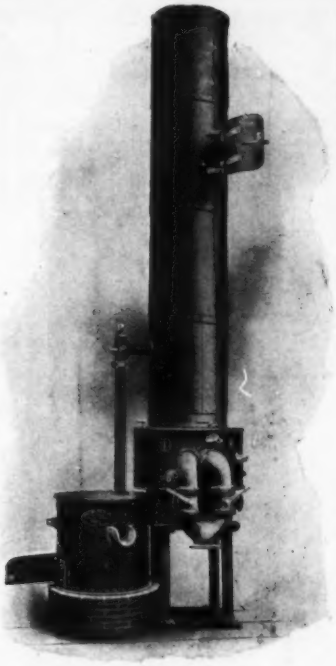
Rockwell Lift-out and Tilting Crucible Furnaces.
„ Simplex Melting Furnaces (Oil Fired).
Sand Mixing Machines. Coke Breakers.
Small Cupolas.
Ash Crushing and Washing Machines.
Bristol Indicating. Switchboard, Portable and Recording Electric Pyrometers for Blast Furnaces, Steel Works, Molten Metal, Hardening, Annealing, Testing, etc.

J. W. & C. J. PHILLIPS,

23, COLLEGE HILL, CANNON STREET, **LONDON, E.C.**

Contractors to the War Office, Admiralty, India Office, Crown Agents for the Colonies, British and Foreign Railway Companies.

FOUNDRY PLANT.



"Rapid" Cupolas

WITH OR WITHOUT RECEIVERS
OR DROP BOTTOMS.

Roots' Blowers

FOR ENGINE, BELT, OR
ELECTRIC DRIVING.

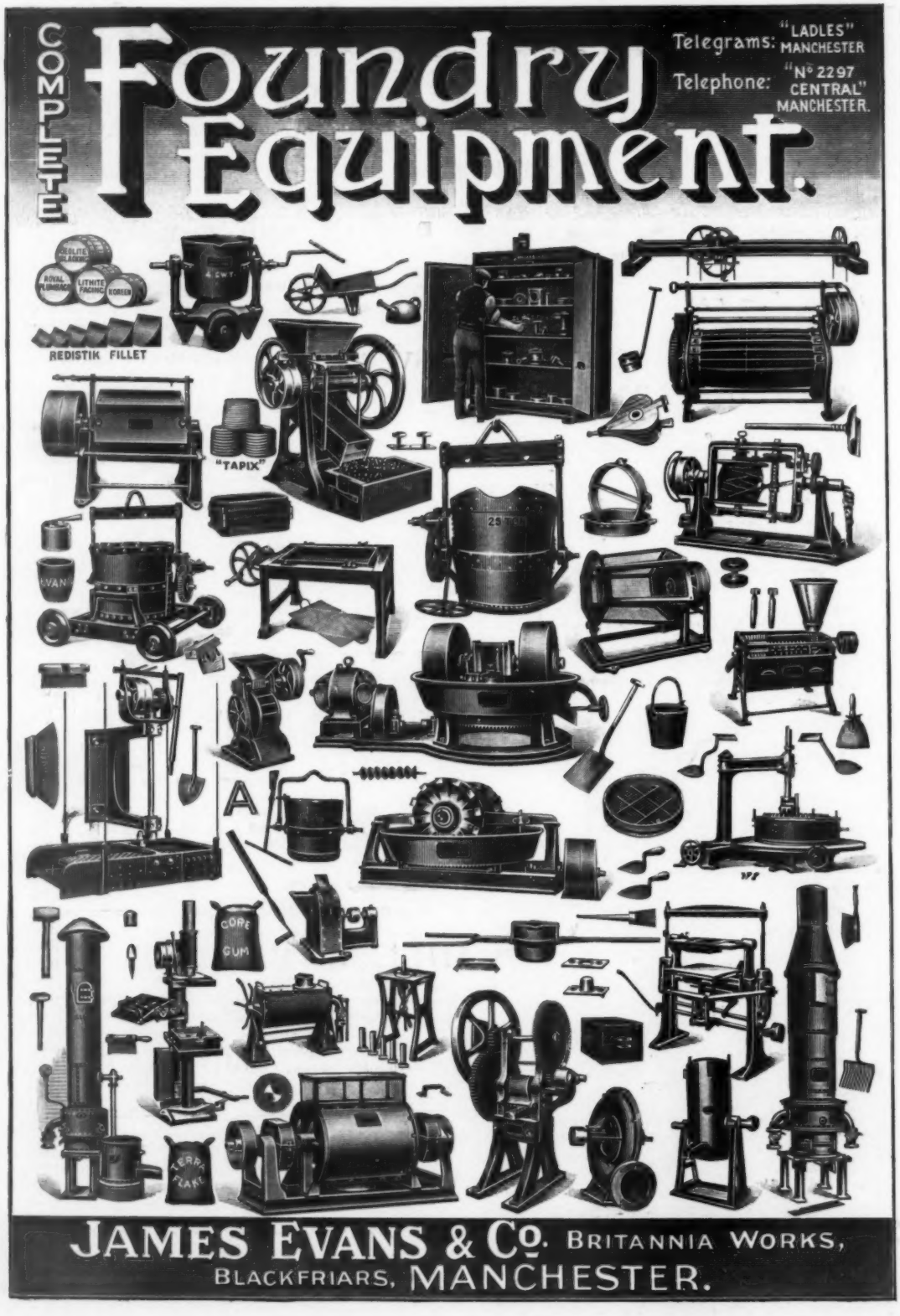
STEAM HAMMERS,
FORGE PLANT,
ROOTS' BLOWERS,
"RAPID" CUPOLAS,
FOUNDRY PLANT.
CENTRIFUGAL PUMPS,
AND FANS.
HIGH SPEED ENGINES
WITH
FORCED LUBRICATION
A SPECIALITY.
THE "BRADFORD" PATENT
BOILER FEED PUMP.
CATALOGUES ON APPLICATION.

THWAITES BROS., Ltd.,

BRADFORD.

LADLES, HOISTS,
PLATFORMS,
JIB CRANES, Etc.

London Office—
96 & 98, Leadenhall Street, E.C.


COMPLETE
Foundry Equipment.
Telegrams: "LADLES" MANCHESTER
Telephone: "No 2297 CENTRAL" MANCHESTER.
REDISTIK FILLET
"TAPIX"
JAMES EVANS & Co. BRITANNIA WORKS,
BLACKFRIARS, MANCHESTER.

TO NEW YORK PUBLIC LIBRARY 210189A ASTOR, LENOX AND TILDEN FOUNDATIONS

The Foundry Trade Journal

AND PATTERN-MAKER.

THE OFFICIAL ORGAN OF THE BRITISH FOUNDRYMEN'S ASSOCIATION.

Vol. 12. **JANUARY, 1910.** **No. 97.**

PUBLISHED THE FIRST WEEK IN EACH MONTH.

Subscription Terms: 7s. 6d. per annum, post free.

To place the "JOURNAL" within the reach of Working Moulders and Pattern-makers the Proprietors will accept subscriptions, not less than three in number from one shop, at the reduced rate of **5s.** per annum, such order to be countersigned by the superintendent or foreman.

All communications to be addressed to the Editor, or to the Publisher, as the case may be, of

THE FOUNDRY TRADE JOURNAL,
165, Strand, London, W.C.

WE INVITE PRACTICAL ARTICLES ON THE TRADE IN ALL ITS BRANCHES, WHICH WILL BE PAID FOR MSS. SHOULD BE WRITTEN ON ONE SIDE OF THE PAPER ONLY.

BRITISH FOUNDRYMEN'S ASSOCIATION.

LIST OF SECRETARIES—

General Secretary: J. E. H. Allbut, Reservoir House, Butterley, Derby.

Manchester: H. Sherburn, Rotherwood. Stockton Heath, Warrington.

Birmingham: C. Heggie, 76, Hillaries Road, Erdington near Birmingham.

Cardiff: H. Griffiths, Messrs. J. Williams & Sons, Ltd., Globe Foundry, Cardiff.

Sheffield and District: Thos. Swinden, 29, Holland Road, Sheffield.

Contents.

	PAGE
Notes and Comments	9
The Progress of Machine Moulding	11
Modern Bronzes	18
Brass Foundry Crucible Melting Furnaces	19
The Cost of Electric Steel Refining	21
New Testing Machines	24
A Report on Cast-Iron Test Bars	27
Briquetting Metal Turnings for Use in Iron and Brass Foundries	29
Thermit Welding	30
A Useful Core-Making Machine	31
Malleable Castings for Automobile Parts	32
"Casting on" Liners on Iron Pump Rams, etc.	33
Cores and Core Binders	34
A Pulverizer for Foundry Coal	37
Buying Carbon Tool Steel on Specification	38
F.T.J. Bookshelf	39
Correspondence	40
Queries	41
Replies	41
Inventions	41
Trade Talk	43
Personal	45
Deaths	45
Legal	46
New Companies	48
Prices of Metals	50

Forthcoming Events.

JANUARY 22.

British Foundrymen's Association (Birmingham Branch).—"Further Notes on Contraction," by Alex. Fraser.

British Foundrymen's Association (Sheffield Branch).—Lecture and demonstration, "The Heat Value of Fuels," by F. K. Knowles.

NOTES AND COMMENTS.

The New Year and Foundry Progress.

The year 1910 has commenced with a somewhat brighter outlook for the foundry trade than has been the case during the past year. In the iron trade generally the closing months of 1909 have seen a distinct revival, and as this is expected to continue throughout the present year it is only natural to look for better times in the foundry branch. With this in view—at a season when in both business and private affairs numerous more or less practicable resolutions are being made and registered—foundry managers who are seeking how best they may take advantage of any coming business opportunities have set themselves to put "their houses in order," and make provision for conducting their works on more economical and effective lines. According to the nature of the individual, this reconstitution of business affairs may take one of several forms; it may be that stricter supervision will be given to the labour employed, or to the materials purchased; it may be that more modern appliances will be installed; or it may be that more scientific methods will be introduced into working of the plant. Whatever course is adopted the aim will be the same—efficiency; but not in every case will success attend, for there are several essentials to be observed that are not always clearly understood. Whenever any new departure is introduced into a works it must first be such as will not interfere with the harmonious working of the plant; also it must not increase the expense of operating without at the same time proportionately increasing the quality or quantity of the output. It is quite possible, for instance, to institute chemical examination of the materials used and to so incur considerable expense, without materially increasing the quality of the product, or to instal moulding machines and operate them without effecting any material saving in the moulding expenses. These are quite familiar facts, and have often proved discouraging to the would-be progressive foundryman, but must not be taken as conclusive evidence in any direction. The services of the chemist are invaluable, but they must be employed to some definite end, and not be wasted on operations that have no serviceable object. Moulding machines, too, must be selected according to the requirements of the work being produced and likely to be produced, or they may readily prove themselves simply expensive toys that do not enter into the everyday operations of the foundry. In the selection of moulding machines it is very necessary to take expert advice on the style and class most suitable for the particular work, and when the machines have been installed the operators should be trained to get the greatest possible output from them at the least cost, having, of course, due regard to the quality of the moulds turned out. There is often more labour entailed in installing a new apparatus in a foundry than is generally appreciated, and accordingly it is not surprising that many men revert to old and

laborious methods, even after having tried modern appliances. But however such men may down-cry machinery and deplore the decline of the old class of worker, we cannot but welcome the relief from some of the old arduous tasks that were once the common lot of the moulder; and when the cry of lost individuality in workmanship is put forward in opposition to mechanical appliances, despite the objectionable features which may be associated with the use of machinery, there rise visions of the drudgery that can be saved by it. So, in considering the problem of foundry progress it is very necessary to give heed to all the factors to be taken into account if success is to be attained. The workers must be assisted to do their best; they should be relieved of the heavy tasks that can be done equally well by labour-saving appliances; they should be given the best materials compatible with cheapness, in order that labour costs be not unduly high; the work should be arranged so that there is a minimum of waste operations; and the operations throughout should be supervised so that each job is done by the most suitable man, no time is wasted wilfully, and no more materials wasted in the course of working than is necessary. If these points are well looked after a good deal will be done to secure efficiency and assist in obtaining what we wish for every one of our readers—a share of a very prosperous New Year.

British Pig-Iron in 1909.

According to statistics compiled from manufacturers' returns by the British Iron Trade Association, the total production of pig-iron in the United Kingdom for the first six months of 1909 was 4,715,679 tons, which compares with a production of 4,653,989 tons in the previous half-year, thus showing an increase of 61,690 tons in the first half of 1909. The production of the first half of 1909 according to districts, was as follows:—Scotland, 672,467 tons; Cleveland, 1,257,203 tons; Durham, 559,863 tons; West Cumberland, 348,198 tons. Lancashire, 228,570 tons; South Wales, 373,894 tons; Derbyshire, 284,012 tons; Notts and Leicestershire, 70,334 tons; South Staffordshire, 248,662 tons; North Staffordshire, 151,135 tons; South and West Yorkshire, 137,975 tons; Lincolnshire, 171,568 tons; Northamptonshire, 150,145 tons; North Wales, Shropshire, etc., 61,653 tons; total, 4,715,679 tons.

Of the 1909 half-year's production 2,144,527 tons were forge and foundry iron; 1,713,461 tons Bessemer hematite; 690,570 tons basic; and 157,566 tons speigeleisen, ferro- manganese, etc.

The most notable increases in 1909, as compared with the previous half-year, are recorded in South Staffordshire (39,000 tons), Scotland (30,000 tons), Lancashire (23,000 tons), Durham and North Staffordshire (15,000 tons each), while the largest decreases were in Lincolnshire (33,000 tons), Cleveland (22,000 tons), and South Wales (17,000 tons).

In the following table the outputs of pig-iron in the United Kingdom for the half-years of 1909 (first half only), 1908, 1907, 1906, and 1905, are compared:—

Half year ended	Tons. 1909.	Tons. 1908.	Tons. 1907.	Tons. 1906.	Tons. 1905.
June 30th	4,715,679	4,635,851	5,194,712	4,905,421	4,621,600
Dec. 31st	—	4,653,989	4,729,144	5,243,964	4,971,137
Totals for each full year ...		9,289,840	9,923,856	10,149,388	9,592,737

From the above figures we notice the production rising to its highest point in the latter half-year of 1906, since which time the production steadily declines till the half-year ended June 30, 1908. The latter half of 1908 was, however, marked by an increase of 18,138 tons over the first half, and the half-year ended June 30, 1909, shows a further gratifying improvement of 61,690 tons.

In forge and foundry iron there is a decline of 11,000 tons in each of the last two successive half-years. The production of basic has increased by 121,000 tons; though, when compared with the first half of 1908, the increase is only 40,000 tons. The figures for hematite and spiegeleisen during the last two half-years exhibit a steady upward tendency since the depressed half-year ended June 30, 1908.

Iron castings, as given in pig-iron manufacturers, returns, amounted to 9,555 tons, as compared with 14,189 tons in the same period of 1908. The largest quantity was made in Derbyshire, namely, 4,807 tons, while Cleveland, Scotland, and Northamptonshire each produced about 1,000 tons, and South Wales 900 tons.

A new heading, "Molten Iron for Steelmaking," was introduced into the schedules sent out for the half-year ended June 30, 1909, and it was thereby ascertained that 587,886 tons of this iron were made during the half-year, consisting of 455,464 tons of basic quality, and 132,422 tons of hematite.

Ground Ferro-Phosphorus for the Foundry.

The use of ground ferro-phosphorus for foundry work has been experimented with, and successful results have been obtained by one manufacturer of this alloy, who has established a mill for grinding it at the Rockdale furnace, Rockdale, Tenn. Only high grade ferro-phosphorus is put into the ground material, the phosphorus content running uniformly about 20 per cent. The crushing rolls are adjusted to one-eighth of an inch apart, and owing to its coarse crystalline nature, the material is all practically reduced to a powder, only a very small proportion remaining in the form of fine lumps. In the foundry ground ferro-phosphorus naturally finds its use in correcting the difficulties arising from the pressure of too little phosphorus in the iron, and widening the range of product possible without a change in the mixture employed. The usual practice is to deposit a small quantity of the powder in the bottom of a large mixing ladle, from 2 or 3 up to 15 pounds to a ton of iron. As the molten iron is tapped from the cupola, it immediately absorbs the alloy. It is particularly adapted for work where thin castings and delicate impressions are desired. The extra phosphorus content necessary to turn out intricate castings can thus be got without any interference with the usual method of charging the cupola. Because of its ability to increase the phosphorus content of any iron, this alloy is generally employed in small quantities wherever great fluidity and reduced shrinkage are sought.

The Founders' Company Competitive Exhibition, 1910.

It is announced that, at Ironmongers' Hall, Fenchurch Street, London, on June 7 and 8, the Master, Wardens and Court of Assistants of the Worshipful Company of Founders will hold an exhibition of metal castings as examples of founding, also of designs and models in suitable material for making castings from, by founders, designers, craftsmen, apprentices and improvers engaged in the foundry and allied trades in England. Money prizes, medals, and certificates will be awarded. The freedom of the Company may be given for any work of special merit. Full particulars can be had on application to Mr. C. F. Corbould-Ellis, Clerk to the Founders' Company, Founders' Hall, St. Swithin's Lane, London, E.C.

The Progress of Machine Moulding.

British Foundrymen's Association.—Birmingham Branch.

There was an unusually large attendance at the meeting of the Birmingham branch of the British Foundrymen's Association held at the Birmingham Municipal Technical School, on Saturday, November 27. The subject for discussion was "Modern Foundry Practice," and the lecturer was Mr. H. S. Green, of London, who dealt with the use of moulding machines. Mr. R. Mason (President of the Branch) was in the chair.

The CHAIRMAN said that the subject of the lecture was one in which they were all very much interested, and in which they would have to take still more interest in the future. Undoubtedly moulding machines were coming more and more to the front. Mr. Green had for more than eight years been connected with

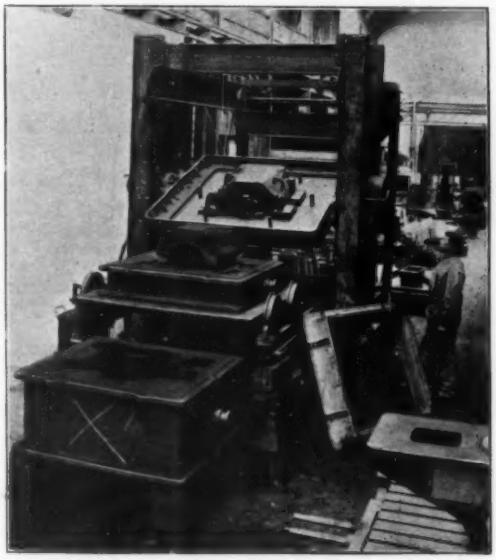


FIG. 1—HYDRAULIC TURNOVER AND PATTERN-EXTRACTING MACHINE FOR MOULDING MOTOR CASES.

the moulding machine business, and therefore he would no doubt be able to throw light upon many of the points about which they had misgivings. In a number of places moulding machines had been adopted, and after a short trial rejected. That was not necessarily always the fault of the machine; it might be the fault of the moulder or the foundry manager, or it might be due to their not having a sufficient number of things to be made, or to the fact that the article they manufactured did not lend itself to being moulded on the machine. Mr. Green had been "up against" all these questions, and would be pleased to answer any enquiries they might wish to make. He (the President) hoped that a great many questions would be asked and that they would do their utmost to take advantage of Mr. Green's visit.

The lecture, which was illustrated by an abundance of lantern slides, was followed with the greatest interest.

The lecturer said that the machines of which illustrations were to be given, were chiefly those in use in other countries, as their Continental friends were doing a great deal more in the way of machine moulding than was being done in this country. On the Continent machine moulding had advanced very rapidly of late years, and one had not to go far to seek the cause. As industrial nations our Continental neighbours, more especially in the foundry trade, were very much younger than ourselves. In competing with us for the markets of the world they had a very strong competitor to face. Our moulders had been at the business for generations, and their skill and rapidity had descended from father to son, so that at the present time many of the moulders had attained a surprising degree of efficiency. For the Continental moulders to have attained the same efficiency would

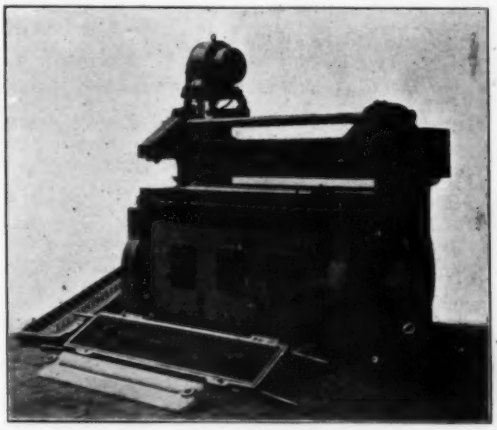


FIG. 2.—PORTABLE MACHINE (ELECTRICALLY DRIVEN) FOR MOULDING RADIATOR TUBES.

have taken far too long, and in some cases it would never have been reached. Consequently they had to resort to machinery in order to meet our competition. As an instance of the immense increase in production brought about by the moulding machine, he mentioned that as far back as 1888 in the stove foundry of Godin & Company, of Guise, it was found that 43 machine operators made the same number of moulds as 300 skilled hand moulders. In 1904 this firm installed two flat table pin-lifting moulding machines which he showed on the screen, and with two men, one working on each machine, produced 45 complete stoves per week. They had now eight of these machines. It was one particularly suited to stove plate work, and had been adopted by German, French, Danish and British stove firms. The export was growing, and in France the largest firm of cooking range manufacturers was now installing these machines. In Great Britain the moulding machine had not been taken up so readily, but British firms were now beginning to understand what moulding machines could do for them.

The lecturer went on to show illustrations of the principal types of moulding machines and other appliances made by the London Emery Works Company. The first type was the hand-ramming turnover machine. This was built in two types up to 8 in. draw with lever extraction, and for deeper draws with hydraulic extraction of the pattern. The first type of machine, the lecturer said, was well-known, so that it was hardly necessary to describe it. It was especially suitable for general work, and only one machine was required for making both the top and the bottom boxes. Plaster pattern-plates, plain iron-plates with patterns screwed on or pattern-plates with pattern and plate cast in one piece could be used on the machine. Hand-moulding machines were found useful in nearly every foundry, the type,

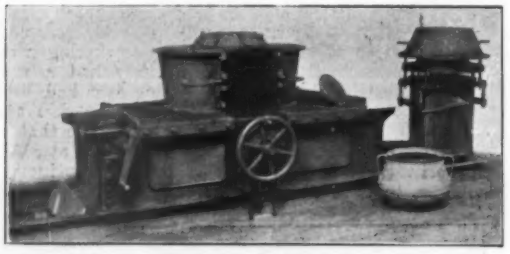


FIG. 3.—COMBINATION MACHINE FOR POT MOULDING.

of course, depending upon the class of work done and the number of castings required. In some cases owing to the saving in metal and the greater cleanness of machine-moulded castings, machines were used where one would hardly think the output justified their use. A very good example of the advantage in regard to output obtained was a pump body with cylinder cores (shown on the screen). Three of these used to constitute a day's work for the skilled moulder, but now with one turnover machine and a flat table lever-press machine two labourers turned out 21 castings in the same time.

For very high patterns or with large machines, hydraulic power for extracting the patterns was re-

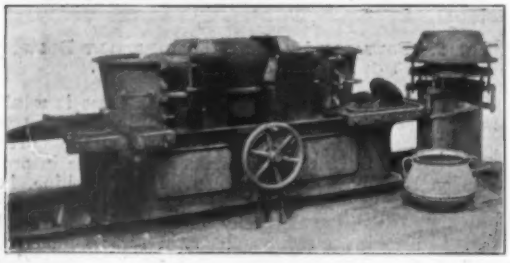


FIG. 4.—MACHINE FOR POT MOULDING; MOULDS DRAWN AWAY FROM PATTERN.

commended. This could be done in either of two ways; (1) by lifting the pattern out of the sand from above, the box remaining firm, or (2) by lowering the box away from the pattern. The first method was employed for high patterns or large boxes, the second for shallower patterns. The first method had several advantages, especially for deep boxes, as the machine could be built lower to ensure a comfortable working height. The operation of the first method was done by two rams in the side cylinders. The pattern shown was a bearing end shield for a dynamo. The boxes were 40 in. in diameter and 24 ft. 6 in. deep. Two men turned out ten complete castings a day. In the next illustration the same type of machine was shown for making lamp columns. The boxes were 11 ft. 6 in. long and 1 ft. 2 in. wide, and two men turned out 10 to 12 columns a day. This was rather an interesting case, as the firm had a number of lamp columns to make all of the same size, but with various ornamentations. Accordingly the patterns of the ornamental parts were all loose pieces, so that with the same machine and the same pattern quite a number of different-looking columns were turned out at the rate he had mentioned. The next illustration showed two machines of the same type for water

FIG. 5.—MACHINE FOR POT MOULDING; MOULD READY FOR CASTING.

closet cisterns. The turnover plate was carried on a crank, so that the turnover lifted up the pattern considerably, and thus it was not necessary to use so much water in drawing out the pattern. Two machines were necessary for this class of work, owing to the thinness of the pattern. Two men with these machines could turn out 65 castings per day. If hydraulic power was not available, a hand-pump, or, for small machines, the town supply could be used for drawing the pattern.

The next illustration introduced the power ramming machine. The machine was of the type previously illustrated, but had the addition of a ram for ramming up the moulds. By this means the output was

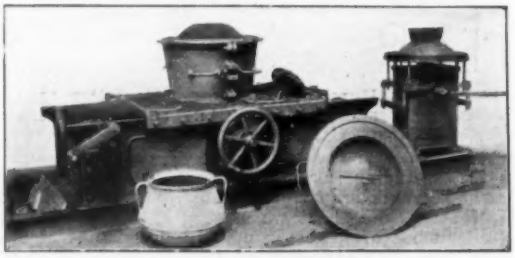


FIG. 6.—MACHINE FOR POT MOULDING; MOULD CLOSED.

considerably increased, and other advantages were secured, such as even ramming, and less danger of damage to patterns. (The lecturer said that he would not discuss for the present the question of pneumatic machines). This machine was fitted with a turnover plate exactly as in the case of the hand-ramming machine; but hydraulic power was used for ramming up the moulds. This particular machine was fitted with a lever for drawing patterns, but for deep patterns hydraulic power was also used for this

purpose. The machine was arranged so that there was ample room for filling in the sand, and for working the machine. A flat rammer head was used, and that was quite satisfactory. The hardness could be regulated by putting in more or less sand. In actual practice it was found that the mould had practically the same degree of hardness throughout; in any case the difference was not such as to cause scabbing. The next illustration was of a hydraulic turnover moulding machine fitted with a pattern for making axle boxes, while beside it was a patent core-making machine for the same work. The boxes were 24 in. by 16 in., and two men could turn out six in an hour, including making the core and the mould. The next illustration was of a machine fitted for hydraulic extraction of the pattern. The pattern in this case was for a roller mill stand, and there were some very difficult places for ramming up. Three men could turn out eighteen stands in a day of ten hours.

It had often been asserted, continued the lecturer, that power ramming machines could not be employed to any advantage on large work, but the machines made during the last two years had quite dispelled that idea. Large machines could be employed with very great advantage. The illustration (see Fig. 1)

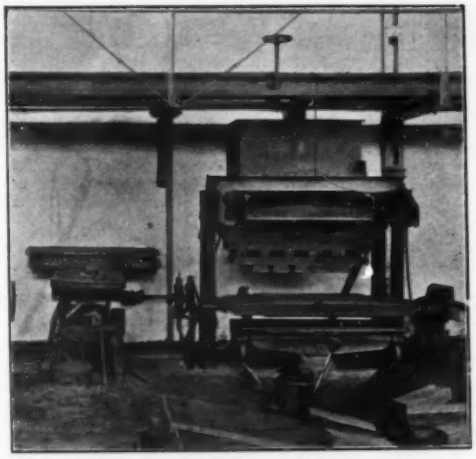


FIG. 7.—HYDRAULIC TURNOVER MACHINE WITH SAND BUNKER.

showed a machine for dealing with cast steel boxes for motor cases. These boxes were 4 ft. by 4 ft., and four men could turn out twelve of them in a day of eight hours' moulding. The lecturer also showed the patterns for these motor cases, and pointed out the large number of templates that was necessary before a start could be made in the making of these patterns.

The next piece of work illustrated was a moulding machine for boiler sections.* The boxes were 5 ft. by 3 ft. 8 in., and four men could produce 28 sections a day. It was a job which, the lecturer thought, few of them would have thought of putting on the machine straight away. The next case also represented a difficult job, namely the use of machines for tunnel plates or tubbing castings.† Practically the whole of the castings of this description for the Paris underground railways were moulded on this machine. The boxes were 6 ft. 6 in. by 6 ft. 3 in., and four men could turn out sixteen castings a day, including the pouring and knocking out of the boxes.

* See FOUNDRY TRADE JOURNAL, September, 1909, page 561.
† See FOUNDRY TRADE JOURNAL, May, 1909, page 282.

The next slide showed a turnover machine for 7 ft. boxes, for locomotive centres. The machine was fitted not only with hydraulic power for ramming the moulds and drawing the patterns, but also with an auxiliary arrangement for removing the bottom carriage on which the moulding box rested. The net weight of the whole was 30 tons, and the weight of the turnover pattern-plate 3 tons; the height was 18 ft. 6 in., the length 18 ft. 3 in., and the width 13 ft. Not the least advantage with machines of this large size was the saving in the cost of repairing patterns. For instance, the firm who had this machine made 120 castings off a wooden pattern, and this, when taken off the machine, was almost as good as new. With hand-moulding repairs would have been required after about every three moulds.

Among the illustrations which followed were some views in the Italian foundry of Messrs. G. Hensemberger. The size of a turnover machine shown was 4 ft. 4 in. by 3 in. 8 in. Another view showed the core-making machine for making the green sand

FIG. 8.—BOXLESS HYDRAULIC MOULDING MACHINE; MOULD COMPLETED IN ONE OPERATION.

cores for syphon bend pipes made on the moulding machine. Two machines for moulding baths were illustrated, one being for making the mould or top box, and the other for making the core or bottom box, the sand being supplied to the moulding box from a bin above. The baths made on this machine were 6 ft. over all, and the output with this machine and a sand-handling plant was now eighteen baths a day, with three men and two boys, including casting and knocking out of boxes. A flat rammer-head was employed, and in this case, instead of the head being pressed down into the moulding boxes, the pattern was pressed into the sand, so that they got an even pressure going into the sand all round. They would see that the core-box was fitted with a rammer-head, and the rammer-head acted as a core-box. The greater part of the machine was below the ground so that the pattern came just on the floor level.

Exhibiting some views of the foundry of Messrs.

Kuppersbusch, where a number of these machines were installed, the lecturer explained that the machine was also made as a double-acting machine—there were two lower portions with tables for taking the pattern-plate, and one rammer-head to serve both sides. These machines were used for small sanitary castings. A view in the foundry of Messrs. Poccardi, Turin, showed a number of these double-acting flat table machines, one of which was fitted with pattern-plates for radiator tubes. The same machine had been adapted for multiple moulding, for certain classes of which work it was most successful. The multiple system of moulding saved moulding-boxes and sand, increased the output, and considerably reduced the amount of floor space required.

A new departure in moulding-machine practice was illustrated in the next machine described (see Fig. 2). This was a portable machine, electrically-driven. It had been designed particularly for dealing with radiator tubes. The ramming of the moulds was done by crank, and the whole of the work was carried out automatically. When once the starting switch was moved over the machine rammed the mould, returned the moulding box to the previous position, drew the pattern, and switched off the motor automatically. The output of the machine, so far, had been 100 castings a day with three men, two moulding and the other coring and cleaning boxes. The tubes were 40 in. long.

FIG. 9.—CORE-MAKING MACHINE; FILLING THE SAND IN THE INTERMEDIATE FRAME.

FIG. 10.—CORE-MAKING MACHINE; INTERMEDIATE FRAME REMOVED AND THE ROUGH CORES READY FOR PRESSING.

In reply to a question the lecturer said that in this work 7½ hours was taken for moulding, and 1½ to 2 hours for casting and shaking out the boxes. He would like to draw attention to the moulding boxes used on this machine. They were what were termed closed boxes, and were moulded with a perforated cover, with holes for allowing the gases to escape, and for pouring. The advantages of these boxes were that less sand was required, that they could be poured on the slope without being clamped with boards on each side, and that they did not require weighing. Pins were used in the clamping.

MR. HEGGIE asked how the down gate was formed, and the lecturer replied that on the machine there was a pin stuck in, and this went through and made the pouring gate.

MR. HEGGIE: Is there a hole in the top corresponding with the gate?

The LECTURER: Yes; in fact all our machines are done in the same way. When you remove this pin after the mould has been rammed it leaves a gate for taking the metal. The lecturer then proceeded to show views of machines which did not require boxes. This type of machine was invented many years ago. It made the top and the bottom boxes at the same time, and closed the mould. One of these machines was in use in the London Emery Works Company's foundry. There were four patterns in the mould, and one man could lay down 220 moulds in eight hours, the size being 16 in. by 12 in. The man who laid down 220 moulds in eight hours, explained the lecturer, turned over his own sand, but, of course, he had his facing sand supplied to him. He had to have two labourers to help him in turning over the moulds and taking out the castings. He "carried away" himself. Of course, if they were going to get an output like that they had to arrange their machine so that the man had not to go far in any direction. Proceeding with the illustrations, the lecturer said that for dealing with tooth wheels two types of machine were made, one with stripping plate, and one with a single-tooth pattern. The pattern was drawn by turning a handle. By turning a lever the machine was reversed, and a hand wheel lifted the box clear of the table pins, so that there was no chance of breaking the mould in that way. Machines were used for making gears 3 ft. in diameter.

Dealing with stripping-plate moulding machines, the lecturer showed one of a general type for engineering castings, and general work. This was seen with eight sets of patterns for engine-end bearings. The machine stripped the pattern, and also raised the box at the same time, the limit being 7 in. Two machines for plough-wheel bushes were shown. The hydraulic moulding machine was employed for making

the top box and the stripping-plate machine for making the core. The boxes were 17 in. by 16 in.; there were twenty-seven patterns in the box, and two men turned out ten boxes an hour. In the special stripping-plate machine for pipe foundries, the lecturer pointed out that the machine was movable, so that it could move along the foundry as the boxes and sand were used up. The boxes could be put out between the rails. The machine was of a convenient height for ramming, and the output obtained was very much larger than with handwork, while the pipes were of more uniform weight—a very important item. In reply to questions, the lecturer said that the sand was kept outside on each side of the machine. When they were knocking their boxes out they put their boxes down between the rails. They could either have the sand in the centre of the rails and put their boxes outside, or *vice versâ*.

Machines for pot moulding, the lecturer said, had not taken on in this country owing to the men at present employed being very expert at the work. On the Continent, however, his firm had supplied a large number of these machines of various types. He illustrated one of the types for large pots. One machine was for making the top box or mould, one was for making the core, and one for assembling the finished mould. For making the core after being rammed up the box was turned over, and the core box was parted by a crank provided. The pots made on these moulding machines were very accurate, and of uniform weight. The next machine shown (see Figs. 3-6) was one designed to do the whole of the work done by the three just described. This machine combines the operations of making the top box or mould, making the core, and assembling the finished work. Fig. 3 shows the machine with the moulds rammed up and the top box lifted from the pattern-plate on the machine shown on the right. Fig. 4 shows the moulds drawn away from the patterns. In Fig. 5 the patterns are lowered into the centre of the machine, and the mould is ready for closing. The mould in Fig. 6 is shown closed, and the top box lifted off the flat table machine. Having shown and described the details of this machine, the lecturer gave illustrations of a few pattern-plates that had been made for moulding machines. Among these were patterns for ring-type, self-oiling, and dust-tight lubricating bearings (for moulding on either hand or hydraulic turnover machines), pattern-plates, and castings for the Belgian State Railways, and pattern-plates for special axle box top parts. In the last case the core as well as the mould was made on the machine. He also showed pattern-plates and castings made by the reversible pattern-plate process. This process was designed to enable one pattern-plate to make the complete mould. Many castings could be made in this way, and a considerable saving in the cost of pattern-plates was thereby effected, while in some cases one machine only was needed where otherwise two would be required. The white metal pattern-plates were embedded in the plaster. A variety of other patterns were exhibited, including castings of stove tops, brake blocks, axle boxes, bearing covers, centrifugal pump body, and grinding machine stands, as well as templates and pattern-plates and core plates, used for such work as casting brass taps.

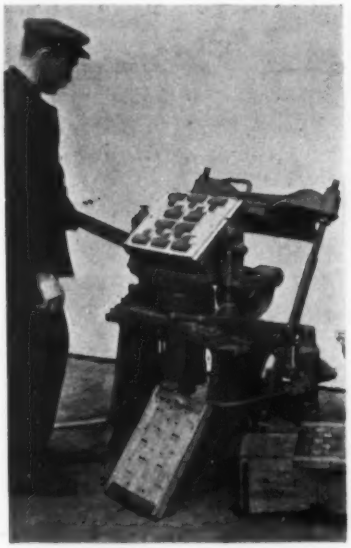


FIG. 11.—CORE-MAKING MACHINE; CORES AFTER PRESSING.

FIG. 12.—CORE-MAKING MACHINE; REMOVING THE FINISHED CORE.

The lecturer then came to the question of core-making machines, which, he said, was one of great interest to all foundrymen. When he spoke on the subject to the Sheffield Branch, the President (Mr. Percy Longmuir) remarked: "There is room for a very considerable advance in core-making machines, with special reference to cores of irregular contour." The lecturer claimed that the core-making machine, of which he now gave an illustration, met at least some of these difficulties. His firm claimed to have provided a core-making machine that would deal with almost any article that could be made in a two-part core box. There were required for the machine two half core plates, an intermediate filling frame, and a carrying away board. In making a core, one half core box was placed on the turnover plate of the machine, while the other half was fitted to the rammer-head of the machine. The intermediate plate, in many cases, was then placed on the lower core plate, and filled in with sand, as shown in the

illustration, Figs. 9 to 12. The intermediate plate was then removed, leaving the cores in the rough ready for pressing. After being pressed the completed core rested in the lower core plate. The carrying away board was then placed on the plate, the whole turned over, and the cores drawn away from underneath. The output of the machine was very large, whilst the cores produced were very accurate, were made in one piece, and required no paste for sticking the two halves together. With the machine using a pair of core plates for bib-cock cores one man made about 96 cores an hour. In the machine for making core plates for wagon bushes were noticeable the grooves for venting. In some cases wire or string was inserted, and pulled out afterwards to make the vents. With another class of core plate the output was 50 cores per hour with one man. Further examples of core-making by machinery were also given.

The lecturer, having shown some other illustrations of core-moulding, went on to speak of the preparation of moulding sands. This subject, he said, had not received in the past the attention it deserved. This was not the case merely in small foundries, but also in the large ones. It was, in fact, practically universal in this country. In many parts of this country we were blessed with a better quality of moulding sand than our Continental friends had. Nevertheless the quality and appearance of our castings would be considerably improved by a little more money and attention being devoted to preparing the sand. The greatly improved results secured by preparing the moulding sand thoroughly had led many large foundries to put up special buildings where this work could be done under the control of capable men.

The first slide in this section of the lecture was a diagram of the sequence of operations required for the thorough preparation of the sand. The new wet sand was delivered into the drying oven, passed to the sifter where any that was fine enough passed into the conveying plant while the coarse sand went to the grinding mill to be ground. Firms not buying their coal-dust ground required a ball mill for grinding it. The coal dust was also delivered into the conveyer. In the meantime the old sand was passed through crushing rollers to break up the lumps, over a magnetic separator to take out the sprigs and pieces of iron, and on to a sieve which retained any coarse lumps, stones, etc. The whole of the new sand, old sand, and coal dust were then delivered into the mixing and tempering apparatus where it was thoroughly mixed and tempered and finally passed through a horizontal sand mixing machine which opened the sand sufficiently for moulding machine use.

The lecturer went on to describe the machines required for carrying out the operations indicated in the diagram. In the first place, there was the apparatus for drying the sand. In many foundries this was done by placing the sand on the top of the drying stove, but where a separate department for sand preparation was kept, a special drying oven had to be installed. This had the advantage that there was an even temperature maintained, and there was no possibility of the sand being burnt. Then, after being dried, the sand had to be screened and ground. The illustration showed the grinding mill with sifter. The sand was delivered into the hopper and passed into the rotating screen, whence any that was fine enough immediately dropped into the storage bins. The coarse material passed into the grinding mill, and after being ground was carried back by the conveyer to be sifted. The next view showed the apparatus for crushing the lumps and sifting the old sand. One roller was fitted with springs so as to allow pieces of iron, such as runners, etc., to pass without damaging the rollers. A conveyer was placed under the screen to carry the sand to the rear of the

FIG. 13.—VIEW IN THE FOUNDRY OF MESSRS. JULIUS PINTSCH, BERLIN.

machine. A magnetic separator was also attached to this machine to take out sprigs and other pieces of iron. Another form of the apparatus was arranged for bolting on to a wall. The sand mixer shown in the next view gave the finishing touch to moulding sand. This mixer was fitted with two grids which rotated in opposite directions, thoroughly opening up the sand and making it fit for moulding purposes. One of these machines was practically essential for every foundry using moulding machines. The next view was that of an apparatus combining the whole of the machines required for successfully and thoroughly preparing moulding sand.

A still more striking illustration was that of the sand-preparing plant supplied to Julius Pintsch, Berlin. The remaining views in this series illustrated the sand-preparing departments in the foundry of Poccardi, Turin, one for old sand and one for new sand; the sand-preparing plant at Siemens & Halske, Berlin, and the sand-preparing department in another Italian foundry, that of Sesto, of the San Giovanni. Some views illustrating ventilation for sand blast shops were also given.

In conclusion, the lecturer said that as the result of a good deal of experience in these matters he would advise them, if at any time they were considering the question of moulding machines, to take the maker of the machine into their confidence. They should not try to hide from him what they might think to be a trade secret. If the man who had got to provide the apparatus was not given the fullest information, it was impossible for him to give them the best machine for the work. But if they treated him with confidence he would respect their confidence, and would be in a position to offer them something that would be of advantage to them and at the same time to himself. (Applause.)

Discussion.

The PRESIDENT said that they had had a very good explanation of the moulding machines in which Mr. Green was interested. He (the President) had thought it just as well to allow a few questions during the lecture in order that the points in which they were particularly interested might be brought out more clearly, especially as it seemed to him that some of them had their doubts about the number of castings turned out. For himself, he still had some doubt, but in one case he had no doubt, namely, in regard to radiator tubes. Mr. Green had told them that three men could turn out 100 a day. In a plant with which he (the President) had had to do, three men were able to turn out 116 a day, and this included carrying the casting and turning out the sand. Therefore, the machine was not up to what they could get without it. They must not forget, however, that where those machines had been put down they had been put down because the skilled labour we had in England was not available.

A member asked what size tubes the President referred to.

The PRESIDENT: Thirty-six inches long by 8¼ in. wide. Continuing, MR. MASON said that when they saw the expense that some firms were going to to put in machines for moulding and apparatus for the treatment of sand it was enough to make some of the old moulders think it a good job that their day was nearly over. He supposed it was simply a matter of time for these things to become general.

The PRESIDENT then invited questions as a preliminary to the discussion of the Paper, and asked the members to confine themselves are far as possible to the moulding side of the question, as the subject of core making would be discussed at their next meeting.

In reply to a question, the PRESIDENT said that the 116 tubes he spoke of were made in a day of less than 9½ hours. It was done all the week and not now and again for speed practice.

The LECTURER said, in reply to a number of questions, that the tubes in his case were 4 ft. long. But they did not make radiator cores on the machine.

The PRESIDENT said, referring to straight cores, that the method of making straight cores was quite simple. He was very much struck by this method of venting with a straight wire. For the last 20 years, he had been making the vent in the same way. He was surprised that it had not been more generally adopted.

MR. HEGGIE asked whether they found with machine moulding they got as good castings at the bottom of the box as at the top.

The LECTURER: We take care that they are not strained. The runner is made of a V-shape, larger at the top and smaller at the bottom for our boxes.

A MEMBER: Don't you find the increased pressure makes the casting coarser?

The LECTURER: The bottom castings are coarser but they are not strained.

The MEMBER: I take it Mr. Green means that in every box the shape of the down-gate is a kind of funnel-shape.

MR. COOK: "That is right." MR. COOK went on to say that there was one point that struck him when the lecturer was describing the ramming up of the moulds. It seemed to him (Mr. Cook), that the theory of ramming was that the sand should be hardest next to the pattern, and that the hardness should gradually die away as the distance from the pattern increased, so that the mould might stand the pressure of the metal and at the same time allow the gases to escape. It seemed to him, however, that in the ramming described, this was reversed. He believed there was a machine which gave a shaking sort of motion, shaking the sand on to the pattern, and eventually one ram at the top so as to make it nice and solid. That seemed to be better than ramming it at the top, which must make it hard under the rammer and soft at the bottom.

The LECTURER said that he could not answer for the second machine because he had not seen it. He knew there was a jarring machine on the market, but he had not seen one with a rammer as well. With hydraulic machines and other methods of ramming, the sand was harder at the top of the mould. That meant that they must have their sand more open than in an ordinary mould, so that they could get their gases off more quickly. But they did not find the casting scab unless they got a very hard mould.

A MEMBER remarked that though the power ramming might seem all right in theory, it was not good in practice. It did not ram easily and steadily right up to the bend where it was wanted. A jarring machine did better. Double hydraulic ramming was better than single, but even that did not touch hand moulding. (Applause.)

MR. COOK: It looks as if you ought to do a certain amount by hand and finish up with the machine.

The QUESTIONER: That is certainly the proper thing, but the lecturer wants to do away with hand ramming altogether.

The PRESIDENT said that the lecturer had ex-

plained that the difficulty was met by piling the sand higher in the middle.

Another member said that he understood the lecturer to say that with the sand properly prepared they would be able to get the necessary ventilation.

The PRESIDENT said that his own experience with moulding machines was that the advantage resulting from their use was that they could use unskilled labour to do the same work as previously was done by skilled men. It was easy enough for a salesman to come round and say that with a machine things could be made more cheaply; but as the patterns had to be got up specially, it might be that credit would be given to the machine which was really due to the patternmaker. (Hear, hear.)

In reply to another question, the LECTURER said with regard to pipe moulding, they had not supplied machines for 9-ft. pipes, but they had for 6-ft. That machine had been a success, but had not been adopted anywhere in this country yet.

The PRESIDENT said that some of the machines they had seen illustrated that evening appeared to him made more to catch the eye than to do effective work. (Applause.) Machines, such as those, no doubt, would appeal to the office, but would not altogether appeal to practical men in the works. That was only his opinion. But he was afraid that was the reason why so many machines were discarded after a little use. It seemed to him that before a firm bought a machine they should consult, not the man who had got to sell it, but the man who had to be behind it, and in that case a large number of machines would not be adopted. The manager was too apt to shove the machines into the foundry without consulting the practical man. In some cases the machine was successful and in others, not.

The LECTURER said that before they sold any machines they always took the foundry manager into consultation. As to machines being discarded, one firm in Sheffield now had 16 machines. They started with one in 1903; then they had five for boxes 40-in. in diameter, after which two for boxes of 4-ft. section, and one for boxes of 7-ft. section. He did not think a firm of that standing would be likely to pay money for moulding machines without being sure that they would be successful. They had had cases in which firms having seen machines elsewhere had sent to them for machines without letting them know what work they were required for, and the machines were applied to purposes for which they would never have recommended them. In cases like that, it was not surprising if the machine failed to come up to expectations. They never advised people to have machines unless they knew what they were wanted for. (Applause.)

The PRESIDENT, in the name of the meeting, thanked the lecturer, and said that they had had a very interesting discussion, and they were very much indebted to Mr. Green for the pleasant way in which he had taken their criticisms. (Hear, hear.)

MR. GREEN briefly replied.

Modern Bronzes.

Before the Sheffield Branch of the British Foundrymen's Association, on November 27, Mr. R. H. Greaves, B.Sc., of the Municipal Technical School, Birmingham, read a paper on "Modern Bronzes." Mr. Longmuir, the President of the Branch, occupied the chair. The paper, which was illustrated by numerous lantern slides, is given in abstract herewith:—

The term "bronze" was applied originally to the copper-tin alloys, but recently has been extended to include alloys of copper with metals other than tin. This is unfortunate, and tends to confusion. The true bronzes include (1) alloys of copper and tin alone, (2) copper-tin alloys to which some other constituent has been purposely added. The latter are "special bronzes." By applying the pyrometer and microscope to the study of bronzes of known chemical composition, it has been found that alloys containing up to 9 per cent. of tin consist, at all temperatures below their freezing point, of a single solid solution of tin in copper. This is known as the α constituent, and is a comparatively soft, malleable and ductile substance. Alloys with 9 to 22.5 per cent. of tin after freezing consist of two distinct solid solutions, the α and β constituents. The β is harder than α, has a higher tenacity, and is less ductile. On cooling, however, at 490 degrees C., the β constituent splits up into a mixture of α with a hard brittle substance δ, which may be the chemical compound Cu_4Sn. These results are embodied in an "equilibrium diagram," which is a valuable guide to the properties and behaviour of the bronzes, though it is limited in its application, as it involves conditions which are not those of practice. By quenching bronzes with 9 to 22.5 per cent. of tin above 500 degrees, the formation of the hard δ, constituent is suppressed, the metal becomes malleable, and shows an increase of tenacity, and elongation. Thus it is found that maximum tensile strength is obtained by quenching at 600 degrees, while the temperature of quenching to obtain maximum elongation varies with the percentage of tin. The properties and industrial value of the bronzes are largely determined by the proportions of the α, β, and δ constituents present. Of the special bronzes actually in use the most important are phosphor bronze, zinc bronze, lead bronze, and lead nickel bronze. Moreover, silicon and aluminium when present in only very small quantities, are beneficial. Manganese may be used up to 1 per cent. in alloys containing more than 90 per cent. of copper, but the simultaneous presence of zinc is necessary to ensure sound castings. Chromium and tungsten have yielded bad results; bronzes with molybdenum, vanadium, and nickel have been tried, but little is known of their properties. In all cases a study of the constitution of the alloys is found to have an important application in practice.

Brass Foundry Crucible Melting Furnaces.

In our issue of July last we described the interesting melting plant installed by the Manchester Corporation for casting special tramway crossings, the furnaces at which plant were installed by the Morgan Crucible Company, Limited. This Company have now kindly furnished us with illustrations and particulars for the following survey relative to melting furnaces for foundry requirements, and the steady growth of what are often referred to by old hands as "mechanical melting furnaces."

Tilting furnaces have been on the market in different forms for a considerable time, but for various reasons they have, until recently, been looked upon with scepticism by the trade, though as has been evinced in foundry discussions recently they are coming much more into favour. The old-fashioned built-up "pot holes" have held their own for generations, but the time has now come for the adoption of more scientific and economical systems of melting, and in this article it is intended to describe some of the various types of natural

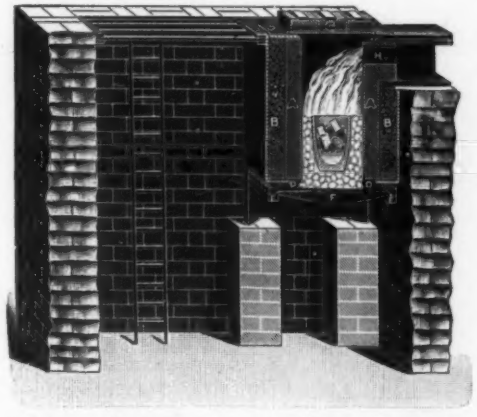


FIG. 1.—SECTIONAL VIEW OF SINGLE FURNACE (CARR'S) SHOWING SOLID LINING.

and forced-draught, tilting, portable, stationary and lift-out crucible furnaces that have been manufactured to meet present-day demands.

For a wide range of work there is nothing yet to take the place of individually-heated, lifted and poured small crucibles, and for such purposes the pit furnaces have not been superseded, and they are likely to be found in general use for many years to come; they suit the requirements of the small foundry admirably, and where a variety of metals and mixtures is required in limited quantities for the daily output there is nothing to offer as an economical substitute for them. In many instances, however, where pit furnaces are installed, either the correct proportions of the furnaces themselves have been neglected or perhaps the provision of flues and chimneys is totally inadequate to properly work the fires; for it is essential, in order to obtain satisfactory results, that every detail should be thoroughly considered for each size of crucible used. The following are the essential points that require very careful attention when equipping a foundry with such melting furnaces:—

(1) The coke space round the crucible must be exactly in proportion to the economical amount of fuel required to effect the melt, and such space will vary with a square or circular furnace lining.

(2) The depth of the fire hole for each size of crucible should be fixed so that there is sufficient coke under the pot to maintain the latter in the proper heating zone, the top of the crucible being, nevertheless, well below the bottom of the flue outlet.

(3) The air inlet area should be proportionate to the size of the furnace, or in other words, to the amount of fuel to be burnt.

(4) The size of flue outlet must be such that the gases do not pass away so quickly as to remove

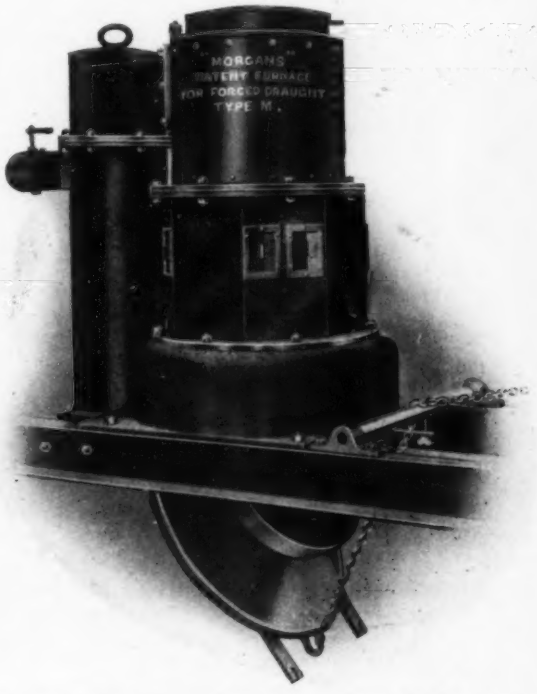


FIG. 2.—DROP-BOTTOM FURNACE; SHOWING METHOD OF LOWERING BOTTOM PLATE AND ASH PAN.

useful heat, and on the other hand, they should not be baffled as to unduly impede their velocity.

(5) The design of flues and chimney must be given every consideration, for the success of a melting furnace, otherwise properly constructed, may be rendered impossible by an unsuitable flue or an inadequate chimney.

In haphazard, built-up fires, the important dimensions which should be carefully fixed for points 1, 2, 3, and 4, are more often than not entirely incorrect, and in consequence coke consumption is excessive, time of melting indifferent, and wear of crucibles out of all reasonable proportion to the amount of metal melted. In the Carr patent crucible melting furnaces, which have now been for many years on the market, it is impossible to depart from standard dimensions (see Fig. 1); the

solid linings supplied ensure the proper coke space, also the depth of fire hole and flue outlet area for the various sized crucibles to be used. The furnaces are self-contained, being constructed of sheet metal sides with angle-iron uprights to form the legs, and to which are attached the firebar suspension lugs; in this way the air inlet area to the fuel chamber is definitely fixed and cannot be accidentally varied.

Referring to Fig. 1, A is the solid fireclay lining; B, space filled solid with broken bricks and fireclay; C, top plates; D, bottom plates; E, carrying bars; F, firebars; G, fireclay cover, iron-bound; H, flue opening to chimney.

A foundryman may, however, find that his demand has increased beyond the capacity of his natural draught melting plant, and further, that he has no means of extending the range of such furnaces; in this event the substitution of properly designed bottom, which is shown partly lowered in the illustration. A fixed ash pan is fitted to this bottom plate, which catches any molten metal that may run through the fire bars, and it is only necessary to remove this metal when cleaning out the furnaces; it will fall away in the form of a shallow cake or ingot when the bottom plate is lowered. This method of recovering lost metal is a great advantage, for, as a rule, with open grate natural draught fires, the spilt metal falling to the pit bottom not only mingles with the accumulated ashes directly under the furnace, but will often spurt in other directions.

The downtake flue arrangement seen at the back of the furnace consists of an outer jacket and an inner cast-iron pipe, the latter having a spiral vane cast on its outer periphery. The hot flue gases passing through the inner tube give up a considerable amount of their heat to the metal pipe, with which they come

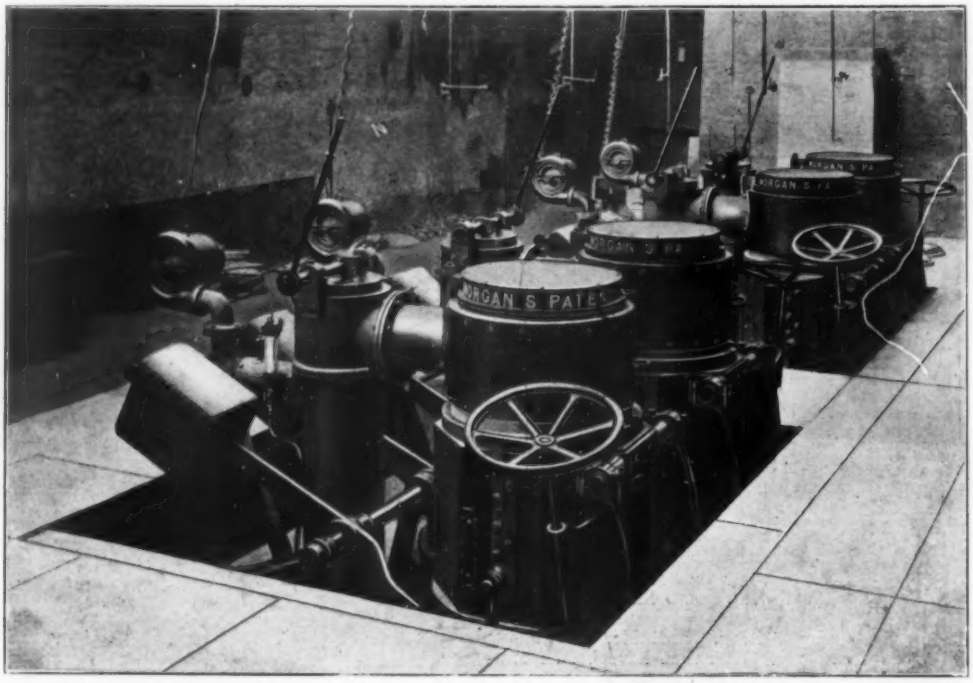


FIG. 3.—INSTALLATION OF FOUR STATIONARY TILTING FURNACES.

forced draught melting plant will often result in increased output from the same floor area by reason of the greater rapidity in melting which would accompany the change. Further, when taking the case of a new foundry equipment scheme, forced draught furnaces may often be recommended for several reasons. For instance, they do not depend on the pull of a chimney stack, so that the outlay in this direction is small; the blower required should be of the low-pressure type, and therefore inexpensive to install, and the running costs of which are low; the output per unit of floor area, as stated, is large compared with natural draught furnaces. To meet such requirements the Morgan's patent furnace, Type M (Fig. 2), has been designed. These furnaces are installed in the usual manner, sunk to the foundry floor level, and the ashes and clinkers are easily cleared by means of the "drop" in contact. The incoming supply of air is circulated through the spiral duct formed between the inner flue pipe and the outer jacket, and in this way the furnace is fed with a hot air blast. The air enters the furnace through the fire bars, and is also dispersed throughout the bed of fuel by means of tuyere holes, so that a fresh supply of oxygen is delivered to the upper layers of fuel, resulting in more perfect combustion, equalisation of temperature, and rapid melting.

The regulation of temperature is a further point in favour of forced draught furnaces, for in the same furnace, to take extreme limits, it is possible to melt, say, zinc, with a minimum loss, and by an increase of pressure and volume of the air supply to turn out a heat of mild steel. For one or other of these two cases the furnace would not be built for the purpose required of it at the time, and the results would not

indicate a high degree of efficiency, but the example will serve to demonstrate the perfect control over the temperature attainable in a well-designed coke furnace with a forced supply of air. Control over so wide a range would be more difficult with, say, natural draught furnaces put down ostensibly for brass melting, and provided, therefore, with a chimney stack designed only to obtain a copper heat.

There are, therefore, special uses for which both natural draught and forced draught pull-out furnaces, taking crucibles of the smaller sizes, are to be recommended, and the next development of general foundry melting plant has been in the direction of furnaces constructed to melt a larger bulk of metal at one time than can be conveniently handled in the pull-out type of furnace. Above a certain size the latter type is out of the question, owing to the risk in handling a crucible containing such a large quantity of molten metal—a risk that is accentuated with every heat taken from the crucible—and for this reason tilting furnaces have come to the fore. By the use of tilting furnaces the output of a foundry is greatly increased, and with those of the portable design the castings can be poured direct from the furnace.

It is chiefly in connection with the running down of scrap and the melting of standard metals that tilting furnaces have now come into more general use, and for such purposes have proved beyond doubt their utility and economy. It is, however, a mistake to think that because a tilting furnace shows a low cost factor of melting in a certain foundry the results will be equally good in another works under altered conditions; each case must be considered upon its own merits, and a suitable size and type of furnace selected to work in with the particular conditions existing in the foundry.

A portable type of furnace is to be recommended where large castings are to be made and for such uses as running liners and heavy pieces direct from the furnace, but for smaller work where hand-carried ladles are preferable a tilting furnace should be of the stationary design; an installation of four such furnaces is illustrated in Fig. 3. The total capacity of this plant is approximately 10,000 lbs. of metal per working day of 9½ hours, each furnace being fitted with a 400-lb. Salamander crucible.

Figs. 4, 5, 6, and 7 show Morgan's patent tilting furnaces (coke-fired) of the A (stationary) and B (portable) type. In the system of melting here employed the air is heated by the outgoing gases from the furnace, as already mentioned in connection with type M furnace, so that the coke fuel is fed with a hot blast, and the glowing crucible walls are not subjected to cold air. When the metal is ready to be poured the upper portion of the furnace is raised sufficiently to enable it to be swung clear of the body. This upper portion or "preheater" accommodates a cylindrical extension of the crucible, in which a supercharge of metal can be run down. The completion of combustion takes place in the preheater, so that a high and useful heat is generated above the main bed of fuel, a point that is more often than not entirely lost sight of in tilting furnaces. Such a loss of useful heat is especially noticeable when the hot gases are expelled into the foundry at the crucible level, or also when an old crucible is used to form a preheater contrivance. An otherwise worn out crucible, with the bottom cut off and so placed, certainly serves the purpose of holding a supercharge of metal, but in some cases it does much more harm than good; this is especially the case when the gases are forced direct through the supercharge, for it is

FIG. 4.—STATIONARY TILTING FURNACE; NORMAL POSITION.

a well-known fact that copper in a semi-molten state will readily take up the sulphurous and other impurities carried off from the fuel, and castings run from metal obtained in this manner will often show signs of defect. In the furnaces shown in Figs. 4 and 6 the plumbago extension cylinder, or "muffle ring," rests directly on the crucible, and being of the same diameter it prevents, as far as possible, the passage of the products of combustion through the supercharge.

(To be continued.)

The Cost of Electric Steel Refining.

Electric furnaces for refining iron are at present generally being worked either at places where cheap water-power is available or at ironworks in connection with other plant. In an article published in the "Rassegna Mineraria," Guido Pullé expresses the belief that a wrong conception is generally made of the cost or cheapness of water-power. He therefore calculates some examples of the prime costs of electro-steel, using a water-power installation on the one hand, and on the other hand where, by the utilisation of the waste furnace gases from a blast-furnace plant, ordinary steel from an open-hearth furnace is converted in the electric furnace into high-grade steel.

FIG. 5.—STATIONARY TILTING FURNACE; POSITION AFTER METAL HAS BEEN POURED.

The author assumes as a basis for his calculations that a blast furnace produces as surplus power 700 h.p.-hours per ton of iron. By the employment of gas engines the cost per kilowatt-hour, according to a statement by Greiner, amounts to 0.175d., of which 0.062d. represents labour alone. Guido Pullé believes that with improved working and the use of the gas he could reduce the cost to 0.152d. per kilowatt-hour. Moreover, as he finds that the Nuremburg Maschinenfabrik state the figure of 0.0868d., he assumes 0.129d. as the correct average value per kilowatt-hour produced by blast-furnace gas-engine plant, and proceeds with his comparison on this basis. In the case of water-power the kilowatt-hour is taken at 0.0883d., according to a price of £2 per horse-power per annum.

The appended examples of calculations refer in the first place to ordinary steel, and secondly to special steel. The difference in the calculation only consists in the circumstance that in the first case 150 kilowatt-hours are employed for the refining of the open-hearth metal, and from 300 to 350 kilowatt-hours in the second case, with a corresponding increase in the electrode consumption. The prices for the charge at the blast-furnace works and the water-power installation are assumed to be equal, there only being included in the case of the latter an addition of 1.6s. per ton for the carriage of the pig-iron:—

(1) Cost of a ton of ordinary steel simply refined at the blast furnace works:—

(2) Cost of a ton of special steel at the blast furnace works:—

	(1) Shillings.	(2) Shillings.	
Charge (pig-iron and scrap, 1,100 kilogrammes at 68s. per ton)	74.80	74.80	
Spiegeleisen, ferro-silicon, lime, &c. ...	2.80	2.80	
Refractory material	4.80	4.80	
Repairs	2.40	2.40	
Labour	4.80	4.80	
General expenses, depreciation, &c. ...	4.00	4.00	
Fuel in open-hearth furnace (blast-furnace gas)	1.60	1.60	for 350 kilowatt-hours.
Cost of current, 150 kilowatt-hours at 0.129d.	1.62	3.78	for 350 kilowatt-hours.
Electrodes, 2.5 kilogrammes	0.48	1.25	for 350 kilowatt-hours.
Total	97.30	100.23	for 350 kilowatt-hours.
	=£4 17.3s.	=£5 0.23s.	for 350 kilowatt-hours.

FIG. 6.—PORTABLE TILTING FURNACE; NORMAL POSITION.

(3) Cost of a ton of special steel at water-power works:—

	Shillings.
Charge as above and freight addition for 222 kilogrammes of pig-iron	75.20
Spiegeleisen, ferro-silicon, lime, &c.	2.80
Refractory material	4.80
Repairs	2.40
Labour	4.80
General expenses, depreciation, &c.	4.00
Fuel in open-hearth furnace (cold charge) 350 kilogrammes (at 16s.)	5.60
Cost of current, 350 kilowatt-hours at 0.0883d.... ...	2.58
Electrodes	1.25
Total	103.43
	=£5 3.43s.

(4) Cost of a ton of special steel produced directly in the electric furnace at water-power works:—

	Shillings.
Charge of 1,080 kilogrammes	73.84
Additions	2.80
Refractory material	5 60
Repairs	2.40
Labour	4.80
Electrodes, 18 kilogrammes (at 192s.)	3 56
Current, 1,000 kilowatt-hours at 0.0883d....	7.36
Total	100.36
	= £5 0.36s.

(Owing to an error in addition, Guido Pullé makes the last example come to 104.26s.) By the above he indicated that the production of electrically refined steel is cheaper when made with power from blast-furnace gases.

Herr B. Neumann, who sets forth the above particulars in a recent issue of "Stahl und Eisen," states that it is not necessary to enter upon a critical examination of the separate items, as the whole account, in his opinion, suffers from a fundamental mistake by placing at approximately 0.12d. the price per kilowatt-hour when employing gas engines using blast-furnace gas. By means of some correct calculations in "Stahl und Eisen," and from reliable statements from practice, it would be found that a price of 0.30d. is much closer to reality. As a consequence the advantages reckoned out by Pullé disappear. Nevertheless, any specialist will agree that the electric furnace is a very valuable complement of every steel plant; also, even if the power at the ironworks costs more than at a waterfall, other advantages come into consideration.

FIG. 7.—PORTABLE FURNACE LIFTED FOR CARRYING TO THE MOULDS.

[NOTE.—In fixing the price at 0.30d. we are inclined to think that Herr B. Neumann has erred on the top side. Some of the most favourable contracts from steam-driven electric power stations in this country are naturally kept quiet, as suppliers do not want to force prices down. But a 24-hour load for all the days of the year is worth having at a very low figure if only part of what we hear is true. We are justified in placing the Guido Pullé figures before iron and steel makers in this country, without, of course, accepting any reponsibility for them.—Editor, F. T. J.]

AMERICAN FOUNDRYMEN'S CONVENTION.—The annual Convention of the American Foundrymen's Association will be held in Detroit, June 6 to 9, 1910, instead of during the week of May 30, as previously announced. The change in date was made in view of the fact that May 30 is Decoration Day. Arrangements are already made for the exhibit, which will be conducted under the auspices of the Foundry and Manufacturers Supply Association, and with the Convention will be associated the annual meetings of the American Brassfounders' Association and Associated Foundry Foremen.

New Testing Machines.

At a recent meeting of the American Society for Testing Materials, a paper was presented by MR. T. Y. OLSEN, of Tinius Olsen & Company, Philadelphia, U.S.A., describing a new hardness testing machine, and a 1,200,000-lb. hydraulic compression testing machine, the latter being designed on the same principle as the large 10,000,000-lb. testing machine recently constructed by the above firm for the United States Government.

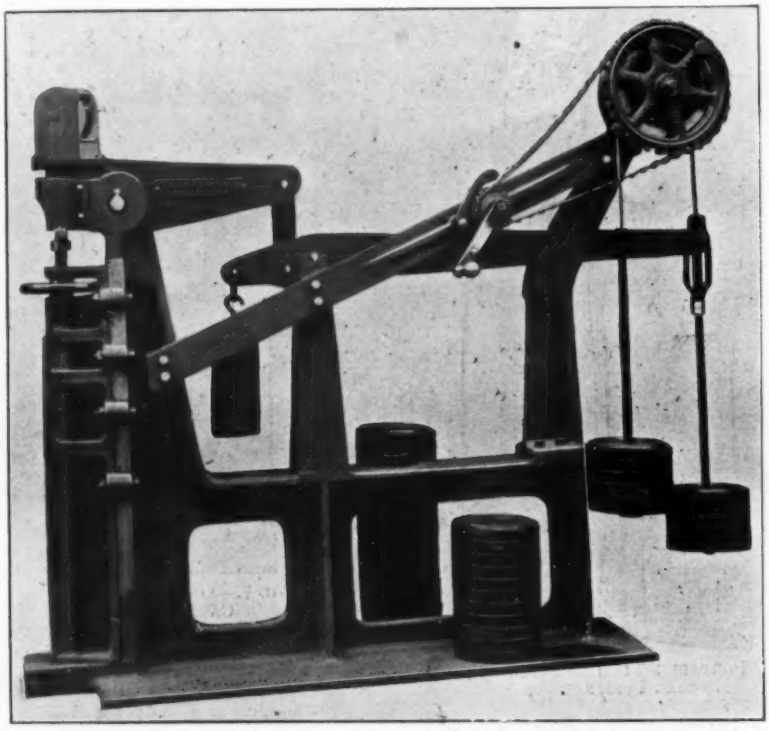


FIG. 1.—NEW HARDNESS TESTING MACHINE.

New Machine for Hardness Test.

In the course of his paper describing this machine, which is illustrated in Fig. 1 herewith, MR. OLSEN remarked that the hardness test for iron, steel and other metals had been greatly used in research work, in the development of high-grade tool steel, in determining the effects of various processes of case hardening, and in other ways. Hardness testing at the present time had stepped beyond the field covered by the research laboratory and was necessary for determining the proper material, from the machining and finishing point of view, for maintaining a constant and uniform hardness in gearing such as is used in automobiles, for determining the uniformity of wheel tyres, and for a number of other practical purposes that could readily be cited. Tests of this nature must be made accurately, quickly, and the machine must be of such construction that it could be operated by the ordinary shop mechanic. For determining hardness, continued MR. OLSEN, there is no better method than the penetration of a standard steel ball under a certain pressure, noting the deformation produced. The difficulty with this method has been the lack of a practical form of machine, one constructed so as to admit of its use in every-day shop practice. The machine I will now describe was designed at the request of Mr. Vauclain, of the Baldwin Locomotive Works, for testing locomotive tyres, as well as other material entering into the construction of a locomotive. The machine consists of two levers mounted on a frame and having a combined count of one hundred. The load is applied by weights at the end of the one lever, which causes the penetration of the steel ball at the end of the other, the specimen being placed between the steel ball and the frame of the machine. The penetration is measured automatically to a ten-thousandth part of an inch by the instrument shown on the top of the main lever.

In making a test on the machine, the gap for inserting the test piece is first set to suit the thickness of the specimen and the crank turned to raise the secondary lever to its highest point, thereby raising the ball and instrument within the hood shown, which acts to protect those parts while inserting the test specimen and also as an abutment against which the specimen is clamped. With the specimen in place an initial load of 10 or 20 lbs., as may be desired, is placed upon it by turning the hand-crank and thus

lowering the lever until it comes to rest. With the initial load on the specimen the pointer of the instrument is set to zero by turning a nurled head until it comes to rest, after which the load may be applied.

The amount of pressure to be applied is kept a constant for any certain material, and the equivalent in weights is placed on the ball suspended from the clevise having the elongated slot in which the lever acts, and is applied to the lever by still further turning the hand crank and lowering the weights until they are suspended from the pivot of the lever. The weights which apply the load to the lever are counterbalanced by the other weights shown, so that all the work the operator has to do is in lifting these counterbalance weights the length of time—a fraction of a second—that it takes to make the penetration. A ratchet and pawl hold the raised counterbalance weights in position until the operator reads the penetration on the dial. The weights are then released, the lever raised to the top position again and the specimen removed; the machine being now ready for the next test. To make a sample test in this machine takes less than a minute, including the time required for inserting and removing the test specimen.

The instrument is entirely encased and all small parts protected so that no damage can occur in ordinary usage. The method of applying the load through a balanced lever system is the most accurate form of applying the pressure, as it is not subjected to variation and can be verified at any time. The instrument can also be readily verified, so that the machine as a whole is as accurate as it can be made. To illustrate the accuracy a piece of high-carbon steel bar made especially uniform through an annealing process was tested in spots along its length varying from 500-lbs. increments up to 10,000-lbs., and the consequent indentations noted were very uniform. Successive increments of 500-lbs. load up to 10,000-lbs., were again applied to the same spot without disturbing the instrument or specimen, and the increments of indentations were again found to be very uniform, the final indentation in each case being the same.

The proper loads to use for various materials, which must be governed to a certain extent by experiment, are as follows:—Babbitts, 500 lbs. to 1,000 lbs.; bronzes, 2,000 lbs.; cast iron, 3,000 lbs.; steel, 5,000 lbs.; special test, 5,000 lbs. to 10,000 lbs.

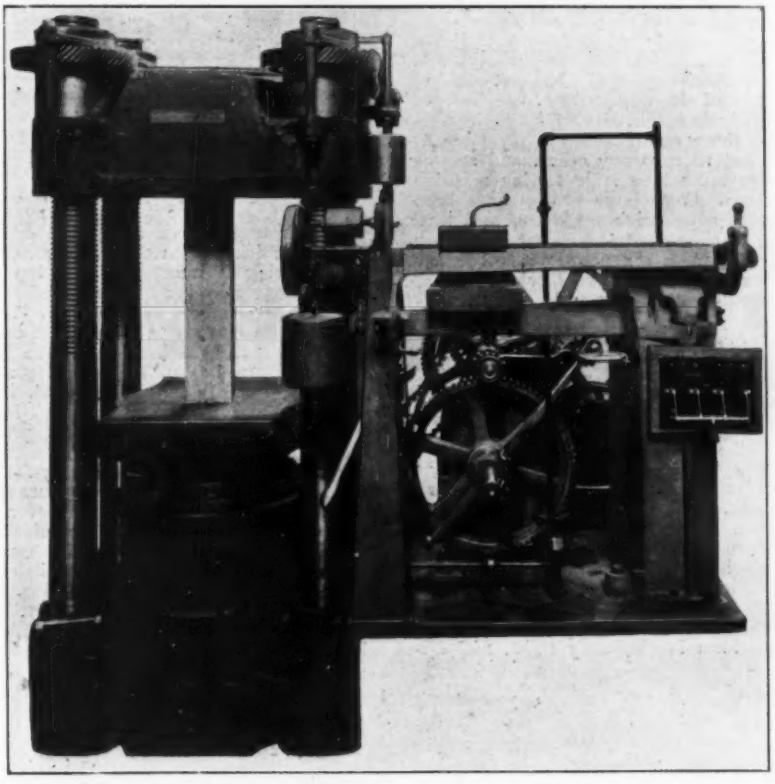


FIG. 2.—HYDRAULIC COMPRESSION TESTING MACHINE; CAPACITY 1,200,000 LBS.

1,200,000-lb. Testing Machine; with Special Reference to a New System of Transmitting the Pressure Developed in the Hydraulic Cylinder to the Scale Beam.

Turning his attention to the above machine, which is illustrated in Fig. 2, MR. OLSEN said that during the past year a new type of testing machine had been developed, which marked a step in advance in the construction of high-pressure testing machines. This type had thus far been developed primarily for compression tests, but in the near future, such a machine would be built to cover not only compression tests but tensile and transverse tests as well.

The main feature of this machine, the author con-

tinued, is the new system of transmitting the pressure developed in an hydraulic cylinder to a scale beam. The standard commercial lever testing machine of to-day weighs the entire pressure directly on a series of three main levers, from which it is transmitted to the scale beam. The size of these levers, and consequently the size of any desired machine, is governed to a large extent by the length of the primary knife-edges, the pressure on which must not exceed 10,000 lbs. per linear inch. Owing to the size, weight and consequent cost of weighing systems on this principle, as well as for mechanical reasons, I would limit the size of this type of machine to 1,000,000 lbs. capacity.

The high cost, and consequent lack, of large testing machines has limited research work and deprived the engineer of data he now requires. Any testing machines, to be of value as such, must work accurately, and must apply the load in such a manner as to uniformity and speed that the specimen will be subject to perfect conditions of loading. The method of support and of adjustment is also of great importance. All of the above qualifications apply more to the compression test than to any other, and assume a far greater importance in a large testing machine than in a small one. Some large presses have been equipped with gauges to weigh pressures, and thus used as a testing machine, but this is not altogether satisfactory, as the gauges are neither accurate nor reliable, and the readings exceedingly coarse.

The testing machine I now wish to describe was designed especially for the new Testing Laboratory of the Rensselaer Polytechnic Institute, of Troy, N.Y., where it is now in successful operation. The capacity is 1,200,000 lbs., and in describing the construction I will divide the machine into four parts :— (1) Press proper; (2) pump and motor drive; (3) adjustment of upper head; (4) weighing mechanism.

The press proper needs but little description, as in general construction it resembles an ordinary press. The crossheads, cylinder, piston and weighing platen are of steel castings, and the four tension rods of 0.40 carbon steel. By thus making all the heavy parts of steel the weight and over-all dimensions are reduced to a minimum, which is of advantage in such a large machine. An important factor in the cylinder is the packing, which is of entirely new design. This new form is absolutely tight, and distributes a uniform amount of friction at all points under any certain loading. It is so constructed that the friction necessary to prevent leakage varies directly with the pressure, thus eliminating the friction as a factor in the weighing system, being cared for in the standardising of the poise on the scale beam. A uniform application of load is an essential point, especially in a compression test of concrete or like material, and with this point in view a special form of pump was devised. This consists of a long steel cylinder in which a piston is forced by means of a screw operated through a series of gears by a direct-connected motor drive. Through this gearing four different pump speeds may be obtained, one exceedingly fast for filling purposes as well as for applying low loads. An automatic cut-off is provided at either end of the stroke of the piston, so the pump can in no way be injured. The pump packing is in such position that it may be replaced in a very short time. With one stroke of the pump the press piston is raised a distance sufficient to break any concrete or stone specimen which may be placed in the machine. Should more motion be required, provision is made for maintaining the pressure in the cylinder and of quickly refilling the pump to provide the motion desired. A two-horse-power motor is sufficient to operate the pump to the full capacity of the machine, as well as operate the upper head.

The four tension rods are threaded at their upper ends, on which are fitted four gear nuts. A ball-thrust bearing is inserted at the top of each nut, and the upper cross-head is suspended from the cover-plate resting on these ball-bearings. The four gears are so connected to each other and the source of power that, by operating a hand-lever, the four nuts are rotated simultaneously, and the cross-head quickly raised or lowered to the desired level.

The method of weighing the load is a departure from all previous methods. The pressure in the main cylinder is transmitted to, and acts on, a diaphragm, which is exactly one twenty-fifth of the area of the main cylinder. The pressure on this diaphragm is communicated to a lever system terminating in a standard dial vernier screw beam. The amount of pressure is in this manner weighed with great accuracy, as the transmission of pressure through the diaphragm is frictionless. The friction in the main cylinder is very uniform, and owing to the type of packing is fully considered in the method of calibration.

CARBORUNDUM FIRESAND. — Carborundum firesand has many valuable characteristics. Among its physical properties it may be noted that it has a specific gravity of 2.7, is of a greyish-green colour, granular, and easily crushed. Chemically, it is classed with the so-called silico-carbides, which are compounds of carbon and silicon, with or without oxygen. In an oxidising atmosphere it slowly undergoes a surface oxidisation. Carborundum firesand is of special interest to the foundryman on account of its wide use in the construction of brass-melting furnaces. With the introduction of fuel, oil, and gas-fired melting furnaces, new conditions were encountered which the various refractory materials heretofore employed could not meet. Certain portions of the lining were subjected to very high temperatures, under which ordinary firebrick, or even magnesite or chromite linings, entirely failed. The most exacting conditions, however, in the matter of resistance to the high temperature of the oil flame and the scouring action of copper and brass slags are met by the use of carborundum firesand. Mixed with the proper binding materials, the entire lining may be rammed up in a solid block, having no joints and presenting a smooth, glazed surface of high refractivity and good mechanical strength. For this purpose silicate of soda is the binder most commonly used. When thoroughly incorporated, the constituents form a plastic mixture which is easily moulded, and has a sufficient cohesion when tamped into place to retain its shape until fired. A centre of iron or wood is provided, the dimensions of which conform to the shape required for the interior of the furnace. The firesand mixture is rammed solidly between the centre and the iron shell of the furnace, and after the removal of the centre the lining is dried out with a slow wood fire. By bringing the furnace slowly up to heat, it can be at once put into service.

A Report on Cast-Iron Test Bars.

At a meeting of the American Society of Mechanical Engineers, held at New York on December 7 to 10, among the papers read was "A Report on Cast-iron Test Bars," by MR. A. F. NAGLE, which we present herewith.

In machinery castings as well as in cast pipes, separate bars are cast and subjected to tensile or transverse stress to the breaking point, these results being used as evidence of compliance with the contract specifications. The writer has examined a large number of such test bars for castings used in the Baltimore sewage pumps; the results show that the test bar is not to be regarded with too much confidence as indicative of the exact strength of the casting.

All transverse bars were nominally 2 by 1 by 24-in. centres. They were cast from two patterns in one mould, made in the same kind of sand as the main casting. The flask was inclined about 30 degrees. There was but one gate for the two bars, with suitable risers. The iron for the bars was poured from a small ladle of iron taken as nearly as possible from the middle of the pour of the main casting. The breaking loads were corrected for varying dimensions of the bars by the formula

$$W' = \frac{Wbd^2}{2}$$

where b and d are the actual dimensions, W the actual breaking load, and W^1 the corrected load of weight. These results are used throughout the paper. The deflections were not corrected.

The tensile bars, 1⅛ by 6 in., were cast upright in the same mould as the main casting, within 3 or 4 inches thereof, and connected by an upper and lower gate. The tensile bars were turned to 1½ in. diameter and threaded, and the middle portion reduced to 1.129 in. diameter, which is equal to 1 square inch area. Table I gives the results of the chemical analysis of the several bars tested.

From August 5, 1907, to April 4, 1908, there were made 67 *single* tensile bars and the same number of pairs of transverse bars, and the average of the latter was used in this record. From April 4 to December 19, 1908, there were made 91 pairs of tensile bars and an equal number of pairs of transverse bars, and each piece of the pair is recorded, instead of the average.

Of these 249 tensile bars and their corresponding transverse bars, 32 sets—26 flat and six round—were rejected for defects due to blow-holes, and four tensile bars were too hard to bear threading, but the companion piece was used in this record. Of the 217 specimens here recorded, 42 were designated as abnormal, that is, the ratio between the tensile and the transverse bars was either considerably greater or smaller than the average.

By referring to Table II., it will be seen that of the 175 specimens of cast iron running from 20,000 to 30,000 lbs. tensile strength, the ratio of tensile to breaking loads is practically 10 to 1 and the deflection 0.45-in.

TABLE II.—*Comparison of Cast-iron Test Bars.*

Number of specimens.	Limit of breaking load of transverse bars.	Breaking loads. Transverse.	Breaking loads. Tensile.	Deflection.	Ratio of tensile to transverse
	lbs.	lbs.	lbs.	ins.	
29	2,000 to 2,200	2,065	21,530	0.43	10.47 to 1
36	2,200 to 2,400	2,289	22,940	0.45	10.02 to 1
51	2,400 to 2,600	2,523	24,880	0.47	9.86 to 1
43	2,600 to 2,800	2,756	26,500	0.49	9.61 to 1
16	2,800 to 3,000	2,804	28,460	0.49	9.83 to 1
175	Averages.	2,383	23,732	0.45	9.96 to 1

NOTE.—Transverse bars, rough 2 × 1× 24-inch centres; tensile bars, turned 1.129 inches diameter (1 square inch area).

Comparison of Test Bars.

Table III. gives 25 abnormal cases where this average ratio is as high as 12.56 to 1 with a deflection of 0.43 in.; also 17 abnormal cases where this average ratio is as low as 7.91 to 1 with a deflection of 0.44 in. And yet the average of both normal and abnormal bars was again very nearly 10 to 1—10.07 to 1.

Breaking loads, presumably alike, varied in pairs of transverse bars, and also in pairs of tensile bars, as follows:—Out of 65 pairs of flat or transverse bars, 14, or 22 per cent., average variation 18 per cent.; 17, or 26 per cent., average variation 5.4 per cent.; 34, or 52 per cent., average variation less than 2 per cent.

Out of 65 pairs of round or tensile bars, 22, or 34 per cent., average variation 15 per cent.; 20, or 31 per cent., average variation 5.5 per cent.; 23, or 35 per cent., average variation less than 2 per cent.; 61 other pairs of flat bars, which had only one companion tensile bar, varied in about the same ratios.

TABLE. I—*Analysis of Cast-iron Test Bars. Bars used in I. P. Bed Plate Cast November* 21, 1907, *and I. P. Frame, Cast November* 26, 1907, *for Baltimore Sewage Pumps.*

Date cast.	Total carbon, per cent.	Graphitic carbon, per cent.	Combined carbon, per cent.	Manganese, per cent.	Phosphorus, per cent.	Sulphur, per cent.	Silicon, per cent.	Tensile strain, pounds per square inch.	Transverse load, pounds per square inch	Deflection, inches.
Nov. 21, 1907...	3.589	2.830	0.75	0.79	0.485	0.081	1.59	24,900	2.440	0.49
Nov. 26, 1907...	3.396	2.736	0.66	0.38	0.459	0.124	1.91	22,000	2,075	0.40

TABLE III.—*Comparison of Cast-iron Test Bars. Abnormal Results.*

Number of specimens.	Limit of breaking load of transverse bars.	Breaking loads, lbs. Transverse.	Breaking loads, lbs. Tensile.	Deflection.	Ratio of tensile to transverse
	lbs.	Above 10 to 1 Ratio.		ins.	
10	2,000 to 2,200	2,088	27,143	0.41	12.95 to 1
10	2,200 to 2,400	2,294	28,530	0.43	12.41 to 1
4	2,400 to 2,600	2,436	29,600	0.49	12.15 to 1
0	2,600 to 2,800	00	00	—	—
1	2,800 to 3,000	2,890	34,000	0.45	11.76 to 1
25	Averages.	2,258	28,365	0.43	12.56 to 1
		Below 10 to 1 Ratio.			
1	2,000 to 2,200	2,105	17,600	0.50	8.36 to 1
4	2,200 to 2,400	2,350	18,825	0.41	7.98 to 1
7	2,400 to 2,600	2,487	18,814	0.43	7.57 to 1
3	2,600 to 2,800	2,656	21,220	0.45	8.00 to 1
2	2,800 to 3,000	2,969	24,500	0.47	8.25 to 1
17	Averages.	2,521	19,954	0.44	7.91 to 1

tinued, is the new system of transmitting the pressure developed in an hydraulic cylinder to a scale beam. The standard commercial lever testing machine of to-day weighs the entire pressure directly on a series of three main levers, from which it is transmitted to the scale beam. The size of these levers, and consequently the size of any desired machine, is governed to a large extent by the length of the primary knife-edges, the pressure on which must not exceed 10,000 lbs. per linear inch. Owing to the size, weight and consequent cost of weighing systems on this principle, as well as for mechanical reasons, I would limit the size of this type of machine to 1,000,000 lbs. capacity.

The high cost, and consequent lack, of large testing machines has limited research work and deprived the engineer of data he now requires. Any testing machines, to be of value as such, must work accurately, and must apply the load in such a manner as to uniformity and speed that the specimen will be subject to perfect conditions of loading. The method of support and of adjustment is also of great importance. All of the above qualifications apply more to the compression test than to any other, and assume a far greater importance in a large testing machine than in a small one. Some large presses have been equipped with gauges to weigh pressures, and thus used as a testing machine, but this is not altogether satisfactory, as the gauges are neither accurate nor reliable, and the readings exceedingly coarse.

The testing machine I now wish to describe was designed especially for the new Testing Laboratory of the Rensselaer Polytechnic Institute, of Troy, N.Y., where it is now in successful operation. The capacity is 1,200,000 lbs., and in describing the construction I will divide the machine into four parts :— (1) Press proper; (2) pump and motor drive; (3) adjustment of upper head; (4) weighing mechanism.

The press proper needs but little description, as in general construction it resembles an ordinary press. The crossheads, cylinder, piston and weighing platen are of steel castings, and the four tension rods of 0.40 carbon steel. By thus making all the heavy parts of steel the weight and over-all dimensions are reduced to a minimum, which is of advantage in such a large machine. An important factor in the cylinder is the packing, which is of entirely new design. This new form is absolutely tight, and distributes a uniform amount of friction at all points under any certain loading. It is so constructed that the friction necessary to prevent leakage varies directly with the pressure, thus eliminating the friction as a factor in the weighing system, being cared for in the standardising of the poise on the scale beam. A uniform application of load is an essential point, especially in a compression test of concrete or like material, and with this point in view a special form of pump was devised. This consists of a long steel cylinder in which a piston is forced by means of a screw operated through a series of gears by a direct-connected motor drive. Through this gearing four different pump speeds may be obtained, one exceedingly fast for filling purposes as well as for applying low loads. An automatic cut-off is provided at either end of the stroke of the piston, so the pump can in no way be injured. The pump packing is in such position that it may be replaced in a very short time. With one stroke of the pump the press piston is raised a distance sufficient to break any concrete or stone specimen which may be placed in the machine. Should more motion be required, provision is made for maintaining the pressure in the cylinder and of quickly refilling the pump to provide the motion desired. A two-horse-power motor is sufficient to operate the pump to the full capacity of the machine, as well as operate the upper head.

The four tension rods are threaded at their upper ends, on which are fitted four gear nuts. A ball-thrust bearing is inserted at the top of each nut, and the upper cross-head is suspended from the cover-plate resting on these ball-bearings. The four gears are so connected to each other and the source of power that, by operating a hand-lever, the four nuts are rotated simultaneously, and the cross-head quickly raised or lowered to the desired level.

The method of weighing the load is a departure from all previous methods. The pressure in the main cylinder is transmitted to, and acts on, a diaphragm, which is exactly one twenty-fifth of the area of the main cylinder. The pressure on this diaphragm is communicated to a lever system terminating in a standard dial vernier screw beam. The amount of pressure is in this manner weighed with great accuracy, as the transmission of pressure through the diaphragm is frictionless. The friction in the main cylinder is very uniform, and owing to the type of packing is fully considered in the method of calibration.

CARBORUNDUM FIRESAND. — Carborundum firesand has many valuable characteristics. Among its physical properties it may be noted that it has a specific gravity of 2.7, is of a greyish-green colour, granular, and easily crushed. Chemically, it is classed with the so-called silico-carbides, which are compounds of carbon and silicon, with or without oxygen. In an oxidising atmosphere it slowly undergoes a surface oxidisation. Carborundum firesand is of special interest to the foundryman on account of its wide use in the construction of brass-melting furnaces. With the introduction of fuel, oil, and gas-fired melting furnaces, new conditions were encountered which the various refractory materials heretofore employed could not meet. Certain portions of the lining were subjected to very high temperatures, under which ordinary firebrick, or even magnesite or chromite linings, entirely failed. The most exacting conditions, however, in the matter of resistance to the high temperature of the oil flame and the scouring action of copper and brass slags are met by the use of carborundum firesand. Mixed with the proper binding materials, the entire lining may be rammed up in a solid block, having no joints and presenting a smooth, glazed surface of high refractivity and good mechanical strength. For this purpose silicate of soda is the binder most commonly used. When thoroughly incorporated, the constituents form a plastic mixture which is easily moulded, and has a sufficient cohesion when tamped into place to retain its shape until fired. A centre of iron or wood is provided, the dimensions of which conform to the shape required for the interior of the furnace. The firesand mixture is rammed solidly between the centre and the iron shell of the furnace, and after the removal of the centre the lining is dried out with a slow wood fire. By bringing the furnace slowly up to heat, it can be at once put into service.

A Report on Cast-Iron Test Bars.

At a meeting of the American Society of Mechanical Engineers, held at New York on December 7 to 10, among the papers read was "A Report on Cast-iron Test Bars," by MR. A. F. NAGLE, which we present herewith.

In machinery castings as well as in cast pipes, separate bars are cast and subjected to tensile or transverse stress to the breaking point, these results being used as evidence of compliance with the contract specifications. The writer has examined a large number of such test bars for castings used in the Baltimore sewage pumps; the results show that the test bar is not to be regarded with too much confidence as indicative of the exact strength of the casting.

All transverse bars were nominally 2 by 1 by 24-in. centres. They were cast from two patterns in one mould, made in the same kind of sand as the main casting. The flask was inclined about 30 degrees. There was but one gate for the two bars, with suitable risers. The iron for the bars was poured from a small ladle of iron taken as nearly as possible from the middle of the pour of the main casting. The breaking loads were corrected for varying dimensions of the bars by the formula

$$W' = \frac{Wbd^2}{2}$$

where b and d are the actual dimensions, W the actual breaking load, and W^1 the corrected load of weight. These results are used throughout the paper. The deflections were not corrected.

The tensile bars, $1\frac{6}{8}$ by 6 in., were cast upright in the same mould as the main casting, within 3 or 4 inches thereof, and connected by an upper and lower gate. The tensile bars were turned to $1\frac{1}{2}$ in. diameter and threaded, and the middle portion reduced to 1.129 in. diameter, which is equal to 1 square inch area. Table I gives the results of the chemical analysis of the several bars tested.

TABLE I.—*Analysis of Cast-iron Test Bars. Bars used in I. P. Bed Plate Cast November* 21, 1907, *and I. P. Frame, Cast November* 26, 1907, *for Baltimore Sewage Pumps.*

Date cast.	Total carbon, per cent.	Graphitic carbon, per cent.	Combined carbon, per cent.	Manganese, per cent.	Phosphorus, per cent.	Sulphur, per cent.	Silicon, per cent.	Tensile strain, pounds per square inch.	Transverse load, pounds per square inch	Deflection, inches.
Nov. 21, 1907...	3.589	2.830	0.75	0.79	0.485	0.081	1.59	24,900	2,440	0.49
Nov. 26, 1907...	3.396	2.736	0.66	0.38	0.459	0.124	1.91	22,000	2,075	0.40

From August 5, 1907, to April 4, 1908, there were made 67 *single* tensile bars and the same number of pairs of transverse bars, and the average of the latter was used in this record. From April 4 to December 19, 1908, there were made 91 pairs of tensile bars and an equal number of pairs of transverse bars, and each piece of the pair is recorded, instead of the average.

Of these 249 tensile bars and their corresponding transverse bars, 32 sets—26 flat and six round—were rejected for defects due to blow-holes, and four tensile bars were too hard to bear threading, but the companion piece was used in this record. Of the 217 specimens here recorded, 42 were designated as abnormal, that is, the ratio between the tensile and the transverse bars was either considerably greater or smaller than the average.

By referring to Table II., it will be seen that of the 175 specimens of cast iron running from 20,000 to 30,000 lbs. tensile strength, the ratio of tensile to breaking loads is practically 10 to 1 and the deflection 0.45-in.

TABLE II.—*Comparison of Cast-iron Test Bars.*

Number of specimens.	Limit of breaking load of transverse bars.	Breaking loads.		Deflection.	Ratio of tensile to transverse
		Transverse.	Tensile.		
	lbs.	lbs.	lbs.	ins.	
29	2,000 to 2,200	2,095	21,630	0.43	10.47 to 1
36	2,200 to 2,400	2,289	22,940	0.45	10.02 to 1
51	2,400 to 2,600	2,523	24,880	0.47	9.86 to 1
43	2,600 to 2,800	2,756	26,500	0.49	9.61 to 1
16	2,800 to 3,000	2,894	28,460	0.49	9.83 to 1
175	Averages.	2,383	23,732	0.45	9.96 to 1

NOTE.—Transverse bars, rough 2 × 1× 24-inch centres; tensile bars, turned 1.129 inches diameter (1 square inch area).

Comparison of Test Bars.

Table III. gives 25 abnormal cases where this average ratio is as high as 12.56 to 1 with a deflection of 0.43 in.; also 17 abnormal cases where this average ratio is as low as 7.91 to 1 with a deflection of 0.44 in. And yet the average of both normal and abnormal bars was again very nearly 10 to 1—10.07 to 1.

Breaking loads, presumably alike, varied in pairs of transverse bars, and also in pairs of tensile bars, as follows:—Out of 65 pairs of flat or transverse bars, 14, or 22 per cent., average variation 18 per cent.; 17, or 26 per cent., average variation 5.4 per cent.; 34, or 52 per cent., average variation less than 2 per cent.

Out of 65 pairs of round or tensile bars, 22, or 34 per cent., average variation 15 per cent.; 20, or 31 per cent., average variation 5.5 per cent.; 23, or 35 per cent., average variation less than 2 per cent.; 61 other pairs of flat bars, which had only one companion tensile bar, varied in about the same ratios.

TABLE III.—*Comparison of Cast-iron Test Bars. Abnormal Results.*

Number of specimens.	Limit of breaking load of transverse bars.	Breaking loads, lbs.		Deflection.	Ratio of tensile to transverse
		Transverse.	Tensile.		
	lbs.	Above 10 to 1 Ratio.		ins.	
10	2,000 to 2,200	2,088	27,143	0.41	12.95 to 1
10	2,200 to 2,400	2,294	28,530	0.43	12.44 to 1
4	2,400 to 2,600	2,436	29,600	0.49	12.15 to 1
0	2,600 to 2,800	00	00	—	—
1	2,800 to 3,000	2,890	34,000	0.45	11.76 to 1
25	Averages.	2,258	28,365	0.43	12.56 to 1
		Below 10 to 1 Ratio.			
1	2,000 to 2,200	2,105	17,600	0.50	8.36 to 1
4	2,200 to 2,400	2,350	18,825	0.41	7.98 to 1
7	2,400 to 2,600	2,487	18,814	0.43	7.57 to 1
3	2,600 to 2,800	2,656	21,230	0.45	8.00 to 1
2	2,800 to 3,000	2,969	24,500	0.47	8.25 to 1
17	Averages.	2,521	19,954	0.44	7.91 to 1

Two special flat bars and two special round bars, cast in one mould, one gate and at one pour, varied as follows :—Two flat bars, 12 per cent.; two round bars, 7 per cent. In order to get some more definite information on these variations, if possible, I had a pair of transverse and a pair of tensile bars made and cast in the same mould, and while the average ratio of tensile to transverse strength was again nearly 10 to 1, as shown in Table IV., the same type of bars again varied 12 per cent. and 7 per cent. respectively.

I have no satisfactory explanation for the great variations in these test bars, and we can only accept the fact that mathematical uniformity in strength of cast-iron bars is not found in the present state of the art. To anyone questioning the results I can only say from my own knowledge of the circumstances that the personal equation did not enter into them.

Careful observation of broken bars did not show that the so-called "skin of the metal" was of any appreciable thickness, and the metal was remarkably homogeneous throughout. The tensile bars being turned, the skin, if there were any, of course disappeared. It is my opinion that the skin adds practically nothing to the strength in either transverse or tensile bars, other causes, though obscure, producing far greater deviations.

TABLE IV.—*Comparison of Cast-iron Test Bars. Special Two Sets Cast in Same Mould at Same Time.*

Number of specimens.	Limit of breaking load of transverse bars.	Breaking loads.		Deflection.	Ratio of tensile to transverse
		Transverse.	Tensile.		
		lbs.	lbs.	ins.	
1	—	2,350	23,000	0.50	9.79 to 1
1	—	2,100	21,470	0.45	10.21 to 1
2	Average.	2,225	22,235	0.47	10.04 to 1
217	All averages.	2,380	23,970	0.45	10.07 to 1

Casting Defects.

Although many castings were condemned for physical defects, such as blow-holes, shrink-holes, sand-washes, and shifting of cores, not a single case of cold-shut was discovered. This is in marked contrast with the writer's experience on similar work in other foundries. Excepting a number of steam valves, which were of iron too soft for their purpose, only one large casting, a discharge air chamber weighing 16,000 lbs., was condemned for being of unsatisfactory iron. In this case the iron was coarse-grained and brittle, and was required to stand at least 23,000 to 24,000 lbs. To remove all doubt that the test bars were truly representative of the iron in the main casting, two tensile bars were cut out of a large flange, which had been at the bottom of the mould. These, from the most favoured part of the casting, as will be seen, stood only about 17,350 lbs.; 90 per cent. of that revealed by the test bars. In this case there was a remarkable agreement among these pairs of bars.

TABLE V.—*Test Bars from Condemned Casting.*

Breaking loads, lbs.		Deflection.
Transverse.	Tensile.	Inches.
1,968	19,800	0.35
2,019	19,000	0.30
—	Cut out of flange.	—
—	17,000	—
—	17,700	—

It may be interesting to apply these results to the formula for the strength of cast-iron beams subjected to similar stress. The commonly-used formula is

$$R = \frac{3\,Pl}{2\,bd^2}$$

where R is called the modulus of rupture, or stress per square inch of extreme fibre; P = load at centre; l = length in inches between supports; and b and d = breadth and depth respectively in inches. Making the proper substitutions, we have

$$R = \frac{3 \times 2380 \times 24}{2 \times 2 \times 1 \times 1}$$

or R = 42,840 lbs. This is not the correct figure, however, for the extreme fibre stress; we know this cannot exceed the tensile strength, which we have found to be 23,732 lbs.

I think it is better to use D. K. Clark's formula, given on page 507 of his "Engineers' Tables," etc.,

$$S = \frac{Wl}{1.155\,bd^2},$$

where S = extreme fibre stress, or tensile strength. If we use the tensile strength found in these tests as 23,732 lbs., the breaking load W would become

$$\frac{23{,}732 \times 1.155 \times 2 \times 1}{24} = 2{,}284 \text{ lbs.}$$

the actual breaking load being 2,383 lbs. As this is within 4.3 per cent. of the average found in these tests, this formula, using the tensile strength for the extreme fibre stress, seems to me to be more intelligible and dispenses with the "co-efficient of rupture."

Mr. Barlow found by experiment that for 1-in. square bars of cast iron, the breaking weight in tons (2,240 lbs., I presume) was expressed by the formula

$$W = \frac{bd^2}{l} \times 13.6,$$

and Robert Stephenson arrived by experiment at exactly the same co-efficient.

If we should substitute the value for W found in these tests we would have W, or

$$\frac{2383}{2240} = 1.064 \text{ tons} = \frac{2 \times 1}{24} \times \text{a constant},$$

or, constant = 12.77, which is within 7 per cent. of the co-efficients found by Barlow and Stephenson.

Circular Test Bars.

Since the foregoing was written I have had the opportunity to observe two circular test bars nominally 1¼ in. in diameter by 15 in. long, with 12-in. centres. These bars were cast from two patterns in one vertical dry-sand mould and poured from a small ladle, first one and then the other, with the results shown in Table VI.

TABLE VI.—*Circular Test Bars Cast in Vertical Dry-sand mould.*

Bar mark.	Breaking loads.		Deflection.	Value of W by formula.	Original diameter.
	Transverse.	Tensile.			
	lbs.	lbs.	lbs.	lbs.	ins.
H	3,344	23,070	0.15	2,948	1.305
H	3,344	23,754	0.15	3,036	1.305
X	3,036	24,670	0.12	3,153	1.300
1	2	3	4	5	6

The tensile bars were taken from the bottom end of the broken test bar, but I do not know whether H or X was poured first. The first tensile bar H

had a small air hole, which being corrected for added 7 per cent. to its tensile strength, and this is also given in the table. A second bar was then turned up from the immediate joining piece with the result recorded first in the table. The turned bars were 0.937 in. in diameter. Column 6 gives the original diameter. Column 2 was found by reducing the actual breaking loads in the ratio of the cubes of the diameters, and column 3 was reduced to the square inch area. Why the transverse breaking loads should vary 10 per cent. and the tensile bars 4 to 7 per cent. the opposite way, a total variation of 14 to 17 per cent., I leave to the reflection of the reader. If we apply Clark's formula for the breaking weights for circular bars,

$$W = \frac{0.7854 \times d^3 \times S}{l}$$

we find the values given in column 5.

In this age of economic production, the cost of these turned tensile bars is frequently objected to by the manufacturer. While blow-holes seem to be more frequent in flat transverse bars than in round attached tensile bars, the latter seem liable to a greater abnormal hardness, for which I have no explanation. Some indication of the toughness of cast iron can be seen in its deflection, which is not revealed in a direct tensile pull. I should, therefore, be satisfied with two or three transverse test bars 2 by 1 by 24-in. centres, and a deflection record poured, as near as may be, from the middle of the pour of the main casting, as giving a fair indication of the iron in the main casting, but mathematical exactness cannot be looked for as yet.

If we wish to know approximately the corresponding tensile strength of the iron, we can multiply the breaking load of the 2 by 1 by 24-in. flat bar by 10. If the test bar is of $1\frac{1}{4}$-in. diameter by 12-in. centres, its breaking load should be multiplied by 8, to obtain the approximate tensile strength. The general rule seems to be, that where both flat bars agree in breaking loads, the tensile strength is 10 to 1 of the breaking load, but where they differ, the 10 to 1 ratio does not hold. A better practice, therefore, might be to cast three round transverse bars and accept the two that agree, if each is round, as a fair sample of the iron, dispensing with the tensile bars.

Briquetting Metal Turnings for Use in Iron and Brass Foundries.*

The utilisation of the large quantities of iron and steel turnings produced in engineering works has attracted attention for a number of years past, and as long ago as 1872 a patent was taken out by Geo. Whitney for treating these turnings in wooden cases in the cupola. But the product so obtained could only be used to a small extent for mixing, and was not entirely satisfactory, a number of works that took up the method having abandoned it as unreliable and unprofitable. Of late years, however, it has been found possible to rectify the defects and produce a metal of excellent quality, by imitating the procedure adopted in briquetting ores. It was thought probable that the failure attending the heating of loose turnings in wooden cases or iron pots was due to their reaching the smelting zone of the furnace in a loose state, whereby they were more liable to burn than when compressed into briquettes, whilst the latter would be more easily broken down for use than pig or scrap iron. These anticipations have been fully confirmed by practice.

Among others, the problem has received attention from Messrs. Leber & Escher, at the Borsig Works, Tegel, Germany, who have found that the briquetted turnings are superior to scrap iron, and adapted to replace more expensive brands of special iron for strong thin castings. White iron was obtained by melting grey-iron briquettes in the closed crucible or the cupola, and instead of a loss of 50 per cent. in re-melting loose turnings, the loss with cast-iron briquettes was only 8 to 10 per cent., this being reduced to 3.5 per cent. when 20 per cent. of pig was added to the briquettes. The re-melting of cast-iron briquettes lowers the silicon content from 2.51 per cent. to 1.27 per cent., the sulphur increasing from 0.105 per cent. to 0.19 per cent., and the manganese from 0.33 per cent. to 0.50 per cent., whilst the phosphorus falls from 0.50 per cent. to 0.44 per cent., and the graphite from 2.68 to 0.12 per cent., the combined carbon increasing from 0.92 per cent. to 1.96 per cent. of carbide carbon, and 0.96 per cent. of hardening carbon. In remelting the briquettes along with various commercial brands of pig-iron, it was found that the sulphur and phosphorus contents increase with the proportion of briquettes, the manganese remaining unaltered, and both the silicon and carbon being considerably diminished.

In consequence of these results the works in question are using these briquettes extensively, especially for locomotive cylinders. The bore and slide-valve face exhibit an excellent grain, and the metal gives a tensile strength that was previously difficult to obtain. Other experiments demonstrated the superiority of the briquettes to several commercial brands of pig-iron, the price of the briquettes (approximately 50s. per ton) enabling a saving of about 25 per cent. to be effected in the cost of cylinder castings. A specially valuable feature of cast-iron briquettes is the uniformity of their metal, which is better in this respect than scrap or commercial pig. They are also easily handled for weighing, etc., and may be stored out of doors without waste, even in winter, besides taking up comparatively little room in storage. Large works would find it to their advantage to make their own briquettes, whilst smaller producers could sell to briquetters, thus finding a market for a product that it now difficult to dispose of, and is mostly used for mending roadways in the works. Turnings of wrought iron and steel can also be utilised in the same way, as well as the heavy turnings produced by high-speed steel tools, these turnings, however, having to be broken down before pressing.

Briquetted turnings can also find application in the production of malleable castings, in Bessemer works, open-hearth work, etc., especially on account of their ease in handling and diminished waste. Experiments are in progress to incorporate ferro-silicon, titanium, etc., with the briquettes, for the purpose of improving the raw material. Corresponding advantages can also be secured in the case of brass, aluminium, copper, etc.

* O. Leyde in "Stahl und Eisen."

Thermit Welding.

The use of the patent welding compound which is now well known under the name of "Thermit," has made great strides during recent years. By the use of this metallic mixture, molten steel at a temperature of about 5,400 degrees F. can be obtained, and repairs of every description to steel castings, forgings, etc., can readily be effected. For most welding purposes "Thermit" compound is used in a specially constructed crucible, the superheated steel produced fusing the surface of the metal upon which it is poured, and uniting with it to form one solid mass. The crucible may be constructed for top or bottom pouring, according to the nature of the work in hand. In the former case the slag which forms on the top of the contents of the crucible as the result of the reaction has to be poured off first, while with bottom pouring the metal is first poured. For the latter method a conical crucible is used, having at its bottom, or point, a hard, burnt magnesia stone, which in turn has a tubular opening with a small magnesia stone fitting therein. This small stone or thimble provides the channel through which the liquid metal is poured. The "Thermit" compound, which is in powdered form, is poured into the crucible and into the middle is placed a pinch of ignition powder, which is fired by applying a fusee. The result of this ignition is to start a chemical reaction in the "Thermit" powder. This reaction is completed in less than half a minute, and gives in the bottom of the crucible a pure liquid steel, covered with a perfectly distinct layer of aluminium slag. The metal is equal in weight to the slag, but occupies only one-third of the cubic space.

When the reaction is completed, the crucible is emptied by tapping it, and the metal is poured directly into the gate of the mould. The mould is constructed as for steel casting, and is made as porous as possible. A riser must be provided, and also an overflow gate just above the level to which the liquid metal is to reach; through this overflow gate the liquid slag is directed and kept apart from the liquid steel.

The surface of the metal to be operated on must be kept free from rust or grease, and should be heated to a red heat. As a rule it is necessary to run part of the liquid "Thermit" metal past the surface to be welded on to, and for valuable and large welds twice or more than twice the amount of "Thermit" steel must be used than would fill the mould, irrespective of runner and riser.

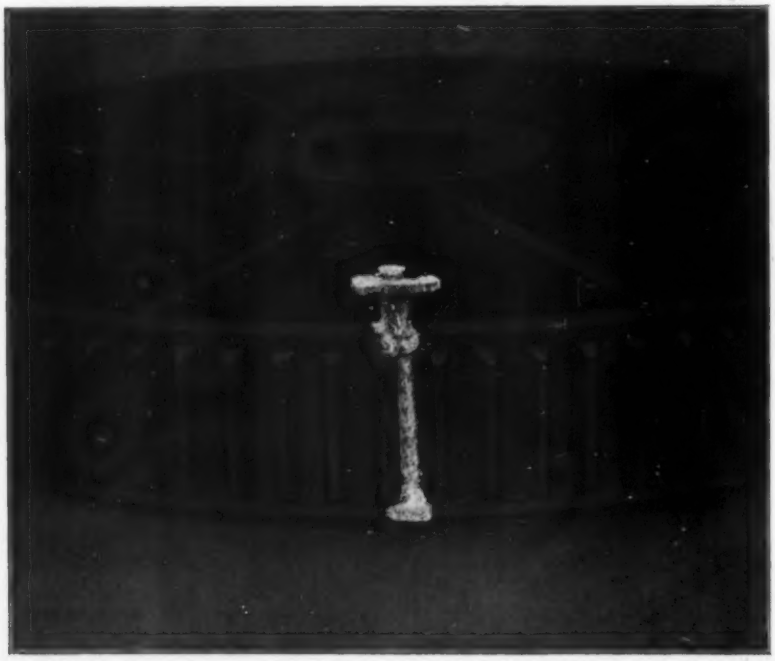


FIG. 1.—REPAIR BY THE THERMIT PROCESS OF A LARGE GEAR WHEEL IN USE AT A COLLIERY.

For some purposes no crucible is required. For example, where a large roller boss is broken off, the roll is placed on end, a mould formed above it, about ½ in. of molten iron is poured on the broken surface and "Thermit" compound is added to the amount of about 30 lbs. to the superficial foot. This is ignited with the help of ignition powder, except in the case of hot liquid steel, the heat of which is in itself enough to effect the ignition, and cast iron or steel in a sufficient quantity to form the new boss is then added and well stirred.

The illustration, Fig. 1, shows the repair of a fracture in a large gear wheel in daily use at a Yorkshire colliery. The wheel, the dimensions of which were—diameter 8 ft., width of teeth 12 in., pitch 3 1-16 in., was of cast steel and weighed 54 cwts. The repair was carried out locally, and we understand the wheel has since been in constant operation with every sign of a sound and effective weld having been made.

A Useful Core-Making Machine.

A system of making green-sand cores by machinery has been perfected, after a series of experiments, by Messrs. Jones & Attwood, Titan Works, Stourbridge, which, they state, is calculated to revolutionise the existing methods of making cores for pipes, columns, etc. The old method of striking up loam cores is certainly somewhat slow and cumbrous, and while the making of sand cores in core-boxes is less objectionable on some grounds, it also has its disadvantages. The machine, which is employed on the new method just mentioned, is designed and constructed so that it can be readily adjusted to make, at one operation, cores either parallel, tapered, bell-mouthed, or for socket pipes, from 2 to 20 in. diameter, and from 10 in. to 10 ft. in length. The cores are struck up or turned on an ordinary tube or core bar, either cast-iron, wrought iron, or steel, by means of a reciprocating steel bar, which presses and fixes the sand on the core bar as it revolves on friction roller bearings.

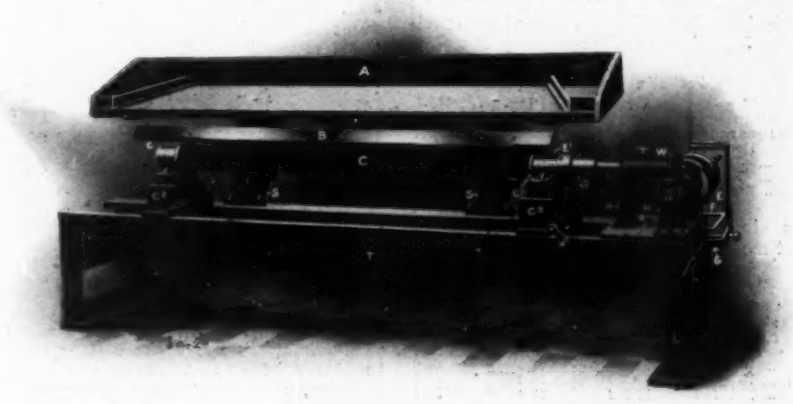


Fig. 1.—A Useful Core-making Machine.

The cores consist of ordinary moulding sand, and it is stated that they can be made in half the time necessary for green sand in core boxes, and in one-third the time of struck up loam cores. Also, they are so firmly fixed that they cannot be shaken off the core bar, and they can be dried in sixty minutes, or may be put into the mould and the casting poured at once.

Referring to Fig. 1, the indicating letters show as follows:—A, adjustable shelf for carrying the sand; B, steel reciprocating bar shaped to suit straight, socket, taper or bell-mouth cores; C, core on core-barrel; C1, collars same diameter as required core; C2, carriage with roller bearings, to carry core barrel, adjusted vertically by means of rack and pinion; D, driver or sliding collar for driving core barrel; E, eccentric; E1, eccentric rod; F, flywheel on main shaft; G, striking gear for driving belt; H, headstock; M1, main shaft brackets; P, pulleys (fast and loose); S, saddle, with adjustable screw motion, carrying roller bracket and sand shelf; W, worm gear, steel worm and wheel.

The machine is constructed to work by power, belt driven with fast and loose pulleys, but if desired may be arranged to work by hand, the power required being so small that a lad can readily drive it. The core barrel (C) makes from six to eight revolutions per minute. the sand is fixed on same by means of the reciprocating bar B, which runs 250 to 300 strokes per minute, by means of eccentric (E) on main shaft. The carriage (C2) with rollers for the core barrel, can be quickly raised or lowered by steel rack and pinion to suit cores from 2 in. to 20 in. diameter. The saddle (S) carrying the reciprocating bar (B) on rollers can be quickly adjusted to suit any diameter of core. All the working parts are boxed in to keep out dust and dirt, and the rack motion in the carriage (C2) carrying the core barrel is also protected from the sand, etc.

Ordinary moulding sand is used, and if the cores are required to be hard, a little gum is added. For brass tubes a special facing is used to give a clean surface.

We have received from Messrs. Alldays & Onions Pneumatic Engineering Company, Limited, Great Western Works, Birmingham, a copy of their new blower list, describing and illustrating their "Climax," Roots blowers and "Empire" pressure blowers. In addition to showing several excellent examples of these apparatus, suitable for all kinds of work, there are also shown exhausters and ventilators for shop uses.

Malleable Castings for Automobile Parts.

From a leaflet recently published by Messrs. Isaac G. Johnson & Company, New York, on the "Danger of Malleable Iron for Automobile Parts," which gives the results of tests made by this firm, we take the following abstract:—

There is a growing tendency among some automobile manufacturers to use cheaper materials than formerly in their cars. No one can take exception to the use of such materials provided they are good enough for the purpose designed, but economy should not be considered at the expense of safety. With the greatest care there is in the production of malleable cast-iron a lack of uniformity, and in its highest grade it is not homogeneous. A careful comparison of the fracture of this metal with that of first-class steel will indicate clearly these conditions. It will be noted that the steel is uniform throughout. The difference in quality between the two metals is emphasised when a comparison of the physical properties is made. Our last test on high grade malleable iron, May 22, 1909, on three specimens gives the following results:—

Test No. 1.

	Tensile strength per square inch. Pounds.	Elastic limit per square inch. Pounds.	Elongation in 2 in. Per cent.	Reduction of area. Per cent.
First specimen ...	45,500	28,250	12.5	19.5
Second specimen ...	45,500	29,000	12.0	19.5
Third specimen ...	45,000	28,500	12.0	19.9

Now note a similar test on our cast steel made at the same time.

Test No. 2.

	Tensile strength per square inch. Pounds.	Elastic limit per square inch. Pounds.	Elongation in 2 in. Per cent.	Reduction of area. Per cent.
First specimen ...	75,125	37,375	37.0	53.6
Second specimen ...	75,000	37,500	31.0	52.5
Third specimen ...	75,000	37,500	32.0	52.0

The superiority of steel is obvious. There is, however, a more important difference still between the two metals, which has been clearly demonstrated by what is known as endurance of vibration test. Bars of the metal to be tested are revolved horizontally at high speed. Weights varying from 30 to 110 lbs., according to the character of the metal, are suspended from the ends of the bars. The weights cause a slight bend or deflection in the bar. The amount of deflection is usually about 0.07 in. When the bar is revolved under these conditions it is clear that it is bent backward and forward as one bends a bit of wire when trying to break it. The number of revolutions the bar will stand before breaking shows its endurance or vibration quality. This is just the test that automobile castings are subject to in service. There is constant and severe vibration due to the unevenness of road, action of engine and explosions in the cylinders. Note the comparative value of malleable iron with steel under this condition. The bars selected for the tests Nos. 3 and 4, were, as in tests Nos. 1 and 2, of the best grade.

Test No. 3.—*Vibration Test on Three Cast Malleable Iron Specimens.*

	Weight on ends of bar. Pounds.	Deflection. Inches.	Revolutions 1st end.	Revolutions 2nd end.
			Broke.	
First specimen ...	80	0.07	97,300	97,100
Second specimen ...	80	0.07	1,700	2,000
Third specimen ...	80	0.07	86,700	87,800

The important fact is here brought out that cast malleable iron is not at all uniform in endurance test. While one specimen withstands 97,300 revolutions before breaking, the next one breaks after 2,000 revolutions. This is what should be expected of a metal that is not homogeneous. The same test on cast steel gave the following:—

Test No. 4.—*Cast Steel Specimens.*

	Weight on ends of bar. Pounds.	Deflection. Inches.	Revolutions. 1st end.	Revolutions. 2nd end.
			Unbroken.	
First specimen ...	80	0.05	30,934,000	30,934,000
Second specimen ...	80	0.05	30,740,700	30,740,700
Third specimen ...	80	0.05	32,183,700	32,183,700
Fourth specimen ...	80	0.05	30,000,000	30,000,000

Not only is there a very much higher endurance quality shown by the steel, but the steel is uniform in this respect. Even after this severe test the steel bars were not broken. It seemed unnecessary to carry the test further because the great superiority of steel was already clearly demonstrated. By using a suitable factor of safety cast steel can be employed without risk, whereas malleable iron may endure for a reasonable time and yet again it may break after giving but a short service.

The pamphlet then cites the case of an automobile hub casting which broke, and which on inspection was found to be made of first-class malleable iron. In finishing a hub casting it is necessary to remove a portion of the exterior metal. This exterior metal is the best part of a malleable iron casting, as can be clearly seen by examining the fracture of good malleable iron. When, therefore, the best of a metal is removed, it is clear that the finished casting will be an uncertain quantity.

BRITISH FOUNDRYMEN'S ASSOCIATION.—BIRMINGHAM BRANCH.—Among the visits arranged by the Committee of the Birmingham Branch of the British Foundrymen's Association during the past month was one to the printing office of the "Birmingham Gazette and Express," Corporation Street. In parties of six, a number of the members were shown, on different occasions, over the composing room, the machine room, and other departments, by Mr. Cotterell, the overseer, and were particularly impressed by the working of the Linotype composing machine. A hearty vote of thanks was passed to the directors of the Midland Express Company and to Mr. Cotterell for their courtesy.

BROWN BAYLEY'S STEEL WORKS, LIMITED, of Attercliffe, Sheffield, have lately installed a second Siemens furnace of 20 tons capacity at their works. The furnace measures 62 ft. by 14 ft., and has been erected by Mr. G. P. Wincott, of Sheffield.

"Casting on" Liners on Iron Pump Rams, etc.

By Walter J. May.

There are two methods of getting gunmetal or brass liners on to the plungers of pump rams and the like; either by casting the alloy on to the iron plunger, or by casting a liner, boring it out, and then forcing it on to the previously turned-up plunger. When well done both methods are good, while each has its own special advocates, but for cheapness the casting-on process is considerably superior to the other, as no turning-down of the iron is required, although the part covered by the yellow metal should be tinned if possible, and if not, it should be brushed clean from oxide and thinly coated with a wash of turpentine and very finely ground plumbago and allowed to dry very thoroughly before being placed in the mould.

One of the peculiarities of this kind of work, however, is the impossibility of getting the metal to cast on soundly in one layer, and for this reason there must be two casts taken in separate moulds, the first layer being more or less full of blow-holes, while the second one comes sound if the metal is clean. Besides soundness of the outside layer of metal, the two successive castings cause the cast-on lining to grip the iron core very firmly —especially if the surface of the iron is rough and irregular—and it takes a great amount of burnishing by rubbing against the pump body to loosen the cast-on metals. At the same time it is always well to pin such liners to the cores.

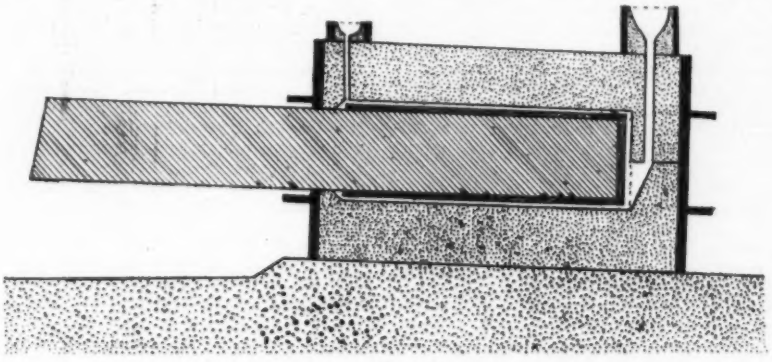


FIG. 1.—"CASTING ON" LINERS.

Two patterns are needed for forming the moulds, one being needed for each cast, and these patterns can be turned-up from any clean, dry wood, having a coat of shellac varnish given them to prevent absorption of moisture from the sand to too great an extent. In the interests of the moulders and also in those of obtaining clean and true castings, the patterns should be split and dowelled, as this secures the best jointing of the moulds with the smallest possible expenditure of labour.

The boxes will have to fit well, and will require a hole at one end for the uncoated end of the plunger to pass through except in the case of short plunger which might be contained in a box about 3 ft. long, but in the latter case the pattern would have to be made with a long point instead of a short one. The boxes having to be in a sloping position when poured, means for supporting the ends of long plungers will have to be provided, but short ones will need brass chaplets to hold the part in the mould if it is heavier than the part bedded in the sand.

The boxes should be arranged as shown in the sectional drawing, Fig 1, pouring being done at the lower end and some metal being allowed to wash through to carry off any dirt from the mould. The metal must be poured hot, and also quickly, while where long liners are needed the iron core should be thoroughly warmed or the metal will chill and not run up freely. Each mould must be freely vented, but the first one does not need such careful finishing as the second one.

As a matter of policy both the first and second moulds should be ready at the same time, and as soon as the first shell of metal cast on is cooled sufficient for the removal of the runner and riser, it should be dressed up, have a thorough brushing with a sharp wire brush, and be inserted in the second mould, this being at once poured. The second shell should remain in the mould until cold, and may then be taken out, fettled, and at once turned up and finished.

Good metal is needed for this kind of work, and just any scrap that happens along is *not* good enough if good results are required.

In some cases white antifriction metal may be desired, and this will have to be cast on in two layers, the iron being excellently well tinned before pouring. Such white metal must be very fluid, and must be poured rapidly with a large runner having a good head, the cup of which is kept full during pouring. A fair amount of the metal should be washed through, and it is a good plan to have the shell longer than will be needed when the plunger is finished, as there is a liability of the top end being somewhat spongy. White metal liners when cast on should always be pinned, as they are somewhat liable to work loose in working against a hard neck where there is a burnishing action. The class of white metal used depends very much on the opinion of the person having the work done, and for this reason the founder has to use what is ordered; and in fact, with this class of work, usually the owner of the plunger or his representative will decide as to what has to be used, the foundryman having only to make a good job of the thing, however awkward it may be.

Cores and Core Binders.

Discussed by Birmingham Foundrymen.

The monthly meeting of the Birmingham Branch of the British Foundrymen's Association, held on Saturday, December 11, at the Municipal Technical School, was devoted to a discussion on "Cores and Core Binders," and, though some of the members had accepted the invitation to join the Birmingham Metallurgical Society at its annual dinner, held that evening, there was a large attendance. The President of the Branch (Mr. Robert Mason) was in the chair, and among those present were Messrs. F. J. Cook (President of the British Foundrymen's Association), Pemberton (Derby), Shaw, Tattersall, E. B. Crump, Grant, Craig, Collinson, H. Winterton, Dalrymple, Heggie (Hon. Sec.), etc.

The PRESIDENT explained that owing to a number of unforeseen circumstances the preparations for the formal opening of the discussion were somewhat incomplete. He hoped, however, that every member, so far as possible, would contribute something from his experience in his own shop, and from what he had seen in other works. It was desirable that each should tell part, if not all, of what he knew on this subject as far as cores were concerned. Many seemed to think they had something that should be kept very quiet, something that nobody else knew, and was quite a secret. As far as core compounds were concerned, there was no difficulty in anyone finding out what was the best to use; it was simply a matter of experiment, and those who imagined that they had something which nobody else knew of were labouring under a very big mistake. Certain firms, no doubt, had their own methods of making cores and core compounds, and found them to answer very well, but anyone else could make the same stuff after a little experiment. He knew very well that some firms forbade their employés to speak about these core compounds, and the Association did not expect any member to give away what his firm might consider a trade secret. But each member should be able from his everyday experience, to tell them something that would be useful.

He had been asked, the PRESIDENT continued, to open the discussion by reading and commenting upon a paper which appeared in "The American Machinist" of February, 1907. The paper, he said, dealt with core compounds, and it was very well known that the Americans had experimented much, and had gone ahead of us in this matter. They were the first, he believed, to use oil, and they had tried several other mixtures. There were numerous special core-binding mixtures which were sold by the foundry supply trade in America, but as far as he knew the basis of most of them was oil—linseed oil or cotton-seed oil. Most of those present no doubt had tried different kinds of core-binders on their own account with the usual varying results. He himself had tried most of the core compounds that had been recommended, but in pronouncing upon their respective merits it should be remembered that what might for one class of work be very effective, might for a different class of work be of no use at all. In this matter, as in others, it was to be expected that a thing would be praised by one man and condemned by another, simply because the second speaker had tried it under different circumstances. Therefore, they should be careful how they spoke, for a certain article might be good in certain circumstances, and not in others.

Reading the paper and commenting upon it, the PRESIDENT said that sulphide extract was a compound which was advertised a good deal in this country about two years ago. It was used a very great deal in America, and was, he believed, some kind of residue from paper-making. A friend of his who had tried it reported that it gave far too much trouble, and could not be depended upon for getting regular results. He (the President), however, believed that a good deal depended upon the drying; the cores made with this compound took a long time to bake and become dried completely through. His friend also told him that the fumes during casting were very obnoxious.

Glucose was another binder very much favoured in American foundries. He had tried it, and in one respect was rather taken down. It was sold by the gallon, and there were said to be so many gallons to the barrel; the barrel looked to him very small for that number of gallons, and he found himself unable to get that number out of it. But, shortly afterwards, he found it stated in an American paper that the American gallon was a good deal smaller than the English Imperial gallon. (Laughter.) This made the glucose very much dearer to use than oil. He tried to use these cores with irons, and found that he had to use a great deal more glucose than they said. The cores were very hard, and the metal would not lie on them, while that was not the case with oil-sand. He was speaking of radiator tubes, 39 in. long. In using this composition he found that the castings at one end would be swollen very badly. He complained to the moulder, and told him that he had not rammed them. Of course, the moulder said he had, and after investigation, he (the President) formed the opinion that the composition gave off some gas which made the mould give. The smell was extremely bad. The gas was not so thick and smoky as that which came from the oil, but it was very bad to breathe. One felt as one did when working with a coke fire, that one's lungs were stopped up.

Coming to cotton-seed oil, the PRESIDENT said that he had used a good deal of linseed oil with satisfactory results. The cotton-seed oil composition was quite as good, but as the oil was dearer, he had not used so much of it. He did not find the fumes in this case so bad as the writer of the paper declared them to be. From his experience he believed that for most of the work of the class he had referred to there was nothing at all better than oil. It was easily used, so long as they could get a sharp sand, but it would not do for sand with any clay in it. The best sand to use was sea-shore sand, or some other sand that had been washed well. That was the only sand to use with oil. As most of them knew, the cores in this class of work were dried in halves. For these cores a very sharp sand was necessary, but for other classes of work a coarser sand was preferable, or they would not get the cores to lift at all when using linseed oil. With boiler cores some rods were put in, but only bits of rods, and when the casting was cold the sand ran out quite freely, and left the inside of the casting quite clean. No blacking and very little venting was required when linseed oil was used.

Mr. Heggie exhibited a few slides illustrative of the different forms of the "Best" core-making machine, and read the descriptions furnished by the makers.

Mr. Cook gave some slides illustrative of core-making, which he had prepared with the assistance of Mr. Collinson. With regard to the Americans being in advance in the use of core compounds, Mr. Cook recalled the statement made at the preceding meeting as to the reason why the French and Germans were ahead of the British in the use of moulding machines, and said that no doubt there was a special reason why the Americans took so readily to core compounds. Probably it was necessary for them to do so owing to special conditions. Perhaps they had not such good sand as we had. Mr. Mason told them that he had used practically all the compounds; but he(Mr. Cook) could say that he had used none other than horse manure. (He the speaker) had brought with him one or two cores made by machines of the "sausage" type, and as the President had told them, these cores were very hard. The mixture of sand for them should vary slightly, according to the size of the core—the smaller the core, the more sharp sand was required. One of the cores he had brought was made with half ordinary loam and half builders' sharp sand. The quantity of oil should vary with the quantity of sharp sand. If they used all sharp sand the extreme quantity of oil was one-eighteenth to give the best results. That was quite good enough for making radiator cores. In mixing the sand it was best to add the linseed oil over-night, so that it could get properly mixed with the sand. Mr. Cook concluded by exhibiting his slides, which represented chiefly cores for torpedo work, and for small gunmetal castings. The last set of slides illustrated the method of dealing with a core for a 30-ton casting.

Mr. Pemberton (of the Midland Railway Works, Derby), said that compounds were certainly necessary for some cores. What they wanted to aim at was a core that could be easily rammed, and that when rammed left the core-box very freely and did not clog it. It should be strong enough, when handled, to stand alone; strong enough when dry to stand the rough usage which cores sometimes had to stand; and should be weak enough to allow the contraction of the iron. It should be easily collapsible, but, of course, in the core they had just seen on the screen, it was most difficult to get the core to collapse. The core should also be porous to allow the gases to escape through it. In making these cores, there were no doubt many core compounds which could be used. There were liquid compounds and solid compounds—flour, resin, gluten, core gum, and several others. Flour made a very good core compound, but the danger with it was, that if they got too much into the mixture they might make it like a loaf of bread. The trouble in that case came when the core was baked; it did not stand the handling as it ought to do. Dextrine was another of the solids. It was, he believed, a kind of flour dust, or wheat dust, and he understood it was used in a good many places. It was a very good compound, but they had to consider the cost of these materials, as they were expected to watch foundry costs very, very closely. Resin, he believed, was one of the best materials it was possible to get as a core binder, but here again there was the question of cost. Another trouble with resin was the difficulty in getting it fine enough to mix with the sand. All these materials should be very, very fine to get them thoroughly mixed with the sand. Among the liquids was fish-oil. That was almost equal to linseed oil for efficiency, but the smell from it was—well, fishy. (Laughter.) Glue was another very good compound, but it had to be used as a liquid. They could not use it very well in its dry state, and he found it best to mix it with hot water. Glutrine was similar, but, as Mr. Mason pointed out, it was sold by the gallon. He (Mr. Pemberton), had used it, but he had found that if it were mixed with sand, and the sand stood any length of time before being used, it began to cake on the top, and it was a very difficult matter once the sand had caked to get it to mix again thoroughly. It required sieving, and very careful attention to get a thoroughly equal mixture. With regard to molasses water, the molasses used was a kind of treacle, and with that one could make a good strong core, but it was of an oily nature, and if the cores were blacked, the blacking would wash off, and a dirty casting would result. The best compound he had found to be core gum. He considered it the best stuff on the market to mix with sand as a dry binder. He was speaking from his experience with regard to sand rammed up into the core box. Linseed oil was the best liquid binding, but unless used with care would be expensive. With the Wadsworth, or "sausage" type of machine, linseed oil answered very well. This machine, however, could not be kept fully employed unless there were a great many cores to be made, as it worked so rapidly. The best mixture he found to be 60 parts of sharp sand, 20 parts of Mansfield sand, and 8 parts of oil. With this mixture the cores would not stand handling at all in the green, though, when dried, they formed very strong cores. He had tried making these cores with flour and core gum, but found that the cores made with this mixture cracked, and the castings got blown. Regarding sands, the speaker said they might have two sands which appeared to be of the same texture when felt, but which would not combine equally well with core mixtures. When the sands were examined under a microscope it was found that the grains of the one were regular and rounded, apparently through the action of water, while the other had its grains angular. This confirmed what had been said of the superior binding power of the sand with angular grains.

A number of slides, sent by Mr. Buchanan, were exhibited, but the descriptive matter was not available. The first slide shown represented a portable oven for drying cores on a system in which the heat was passed through a series of tubes, and the shelves could be withdrawn without loss of heat. Both Mr. Cook and the President commended these ovens, the latter saying that there was no more economical method of drying cores. The reason they acted so well, he said, was that the heated gases passed through the cores, and the quicker a core was dried the better it was. Another slide greatly interested the members as showing the working of the core-making machines* seen during the recent visit to the works of Messrs. Jones & Attwood, Stourbridge. The President said that one thing had struck him as rather surprising, and that was that while great admiration had been expressed for certain classes of pipe core-making machines, most of the pipe works had refrained from adopting any of them.

The President thought that one thing that militated against the use of these machines was the large expenditure that was required for core bars. To get a stock of steel core bars sufficient for a large foundry would mean an outlay of capital, the interest on which, together with the depreciation, would be a serious addition to the standing costs. That seemed to him one of the things which had been against the use of these machines.

* See Page 31 of this issue.

Mr. Cook: I was quite surprised at the rapidity with which the cores were made on this machine. I believe it took a minute and a half for two labourers to make a core for a 4-in. pipe.

Other slides from Mr. Buchanan's collection having been shown, the President resumed the general discussion. Referring to Mr. Pemberton's remarks about resin being one of the best materials, Mr. Mason said that one of the difficulties with resin was to get the core smooth enough. He had used resin with very good results, but only for castings of about ¼-in. thickness. He has used it with thicker castings, but not with good results; there seemed to be too much flame given off. If the resin were not ground very smoothly, it melted and dropped out, and left a hole in the core, with the result that they found in the casting a little round knob quite glazed on the top. One got familiar with this, and recognised it as a sign that too much resin was being used. With regard to fish oil, he had used that, but had had to give it up, because of the smell. (Laughter.) There were girls working in the shop, and they threatened not to work any longer—and that was only with the drying. He knew a firm that used fish-oil for making radiator cores—he believed that it also went under the name of Manhatton oil—and this firm was compelled by the Corporation to put up a higher chimney to the core oven. But, apart from the smell, the oil made good cores that could be easily handled.

The President, continuing, said that the difficulty with regard to the use of glue was that it took too much trouble to dissolve it, and the cores made with it absorbed damp very freely. He took a core made with oil mixture and hung it up in a room for two or three years, and probably it was hanging there now. He had felt it on wet mornings, and had found it none the worse; but with glue the core would not stand even two days, and if the atmosphere were at all damp it soon became quite soft. He had found salt a very good core binder, but if they left the core a couple of hours after drying, it was found to have taken up water very freely. He agreed that core-gum was a very good substance to use, and, as far as he knew, dextrine and core-gum were practically the same thing. For certain articles, core-gum scabbed very badly, and did not leave the inside of the casting so smooth as did cores made with some of the other binders.

Mr. Cook: What quantity of resin do you require?

The President replied that he had not the figures with him; therefore, he would not like to give a definite reply. With regard to the costs, with core-gum or with resin, in the quantities he had used, the sand ran to from 7s. 4d. to 7s. 10d. per ton for the ingredients, and the sand they used was very cheap, as they happened to be in a sand district. At first, when he used oil sand, they paid rather high—as high as 14s.—but latterly it had come down to about 12s. or 12s. 6d.

Mr. Tattersall said that there were many who did not believe in core compounds, but he had found them useful in certain cases, and it might be of interest if he gave a brief account of the cores and sand mixtures used in foundries in which he had been employed. For small cores to go in castings, having a varying thickness of iron from ⅛ in. to 1 in., a good core could be made from the following:—Four barrows of black sand, one of red, and two buckets of coal-dust. Some might raise objections to the presence of coal-dust as tending to the generation of gas, but if the cores were properly vented, no trouble need be expected from this source. Cores made of this mixture were easy to knock out, and left a skin as clean as on any other part of the casting. This was a great advantage in the machine-shops, giving a much longer life to the boring and facing tools. For small pumps, cylinders, and steam presses the following made a good core:—Two barrows of red and one of black sand; one bucket of thin clay-wash, with a handful of core-gum; one riddle of

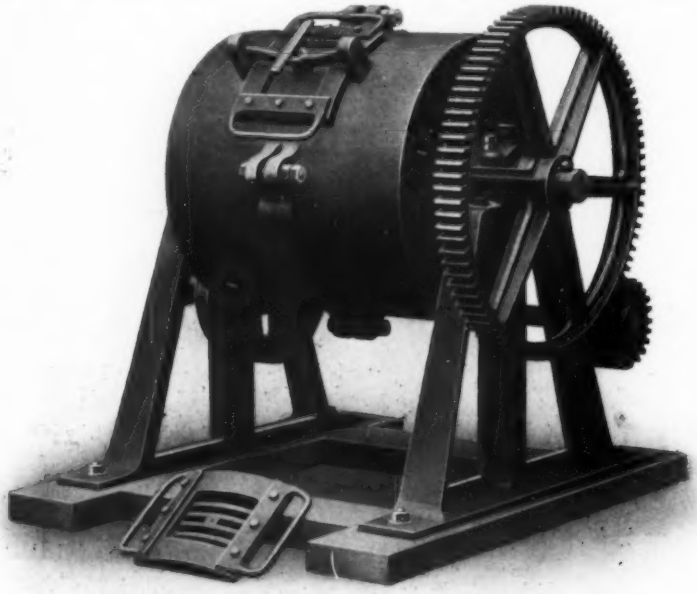


Fig. 1.—Pulveriser for Coal Dust, Etc.

horse dung, put through a ¼-in. riddle, put in the mill and ground as one would loam; dry in the stove, and afterwards take back to the mill for mixing and damping. This was also a suitable mixture for dry-sand work, with about three parts of a bucket of coal-dust added, and leaving out the grinding and drying. He was aware that it was rather difficult to prescribe a standard mixture, as the sand varied in different localities. The sand used in the mixtures he had described was of a fine, tough nature; therefore, the absence, or almost complete absence, of binding materials would be readily understood.

Mr. Cook, speaking with reference to wax wires, said that he was at a foundry some time ago where they told him that sometimes they went along all right, and got very good results, and then would get very bad results. Experiments were made to ascertain the temperature at which the wax melted out, and it was found that some of the wires took about twice the heat that others did. Care was therefore taken to test every consignment, and all wires were required to comply with certain specifications as to melting temperature.

Mr. Fraser said that the diffusion of sulphur vapours was a matter to be considered. In using a very coarse sand, the diffusion was very slow, and it would be very much better to use a light, close sand.

Mr. H. Winterton said that when he was in America he found that the American foundries used a sand that was very different, indeed, from that used in this country. The sand principally used was known as Lakeshore sand. It was exceptionally sharp. As to binders, something had been said about standardisation. That was the thing least of all applicable to core binders. One foundry would swear by fish-oil, another preferred dry core-gum sand, while another would say dry core-gum sand was not a bit of use and insist on having wet gum. He found a great deal of wet gum being used in the United States, while others mixed up dry core-gum to demonstrate to him that that was very much better for their sand. He found himself that it was necessary to use with their sand either very strong core-gum, or a great deal more wet sand than they were accustomed to use. They used sometimes oil, and sometimes gum. Core-gum was very frequently used, and with it the very best cores were made. As to the different melting points of wax wires, that depended upon the quantity of resin mixed with the wax.

The President thanked those who had contributed to the discussion, and added that as that was their last meeting of the year, he would wish them all a very merry Christmas and a New Year very much brighter than the year they had just gone through. (Applause.)

A Pulveriser for Foundry Coal.

The illustrations herewith depict a pulveriser, or cylindrical mill for grinding coal dust, charcoal, etc., for foundry purposes. The drum is made of cast iron 1¼ in. thick, machine faced, with turned axles, strong geared wheels, and a 2-in. steel shaft with fast and loose pulleys. It is fitted on cast standards and mounted on substantial wood base, boxed in with a steel casing built on an angle iron frame. Fig. 1 shows the apparatus without the casing, and Fig. 2 the complete pulveriser and casing.

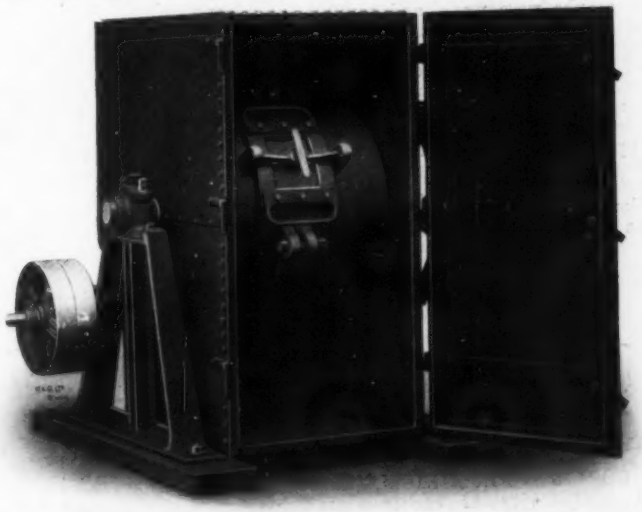


Fig. 2.—Pulveriser and Casing Mounted on Wooden Frame.

Flint pebbles (about 3 cwts.), or cast-iron balls (about 4 cwts.) are put inside the drum, and the coal slack or other material is ground or pulverised as the drum revolves.

When the charge is inserted, the solid cover is screwed down, and when the material is sufficiently ground the cover is removed and the open grid substituted. The door is then closed and the drum restarted, when the ground material drops into the casing, while the pebbles are retained in the drum for the next charge. Practically any degree of fineness can be obtained with this apparatus.

The makers are Messrs. Jones & Attwood, Titan Works, Stourbridge, to whom we are indebted for these particulars.

Buying Carbon Tool Steel on Specification.*

By J. M. Darke.

Three years ago the writer conceived the idea of buying carbon tool steel on a specification basis, in the same manner as many other materials used by large manufacturing concerns are purchased. When the subject was broached to those most interested it was received with little enthusiasm. The manufacturers of carbon tool steel were not in favour of the idea, as it removed at once the value of their brand of trade names, upon which they had spent years of advertising. The shop foremen were somewhat doubtful as to its success, as the idea was radically different from the system under which they had been working for years. Many of them were men of long experience who had used certain brands of steel for years, and it seemed impossible to them that there were dozens of other brands equally good. It is also natural to feel that in adopting a scheme which removes the responsibility of making a choice in selecting steel, something quite personal has been lost.

Others objected to the idea on the ground that "chemical analysis was not the whole thing." This is true in a narrow sense. This same argument was advanced when the chemist was introduced into iron and steel foundries and various other industries. Through the lack of exercising ordinary commonsense, the chemist came very near being an absolute failure in the ironfoundry business. This would be the outcome if chemistry were applied in the same manner to a tool-steel specification.

A large number of manufacturers of carbon tool steel were asked to submit samples representing their various brands. These samples were carefully analysed, photo-micrographs were made, and results compared. It was found that the steels grouped themselves into three grades, one about a 3½d. base, the second about a 7d. base, and the third about an 11d. base; the latter usually being a "double special" steel, and generally containing some alloy. With the above facts in mind, the following specification was drawn up and presented to the trade :—

Specification for Carbon Tool Steel.—1. Tool steel to fill this specification will be required in five classes and three grades, as follows :—

	Carbon. Per cent.
Class No. 1	0 75 to 0.85
Class No. 2	0.85 to 0.95
Class No. 3	0.95 to 1.10
Class No. 4	1.10 to 1.25
Class No. 5	1.25 to 1.40

	Grade A. Per cent.	Grade B. Per cent.	Grade C. Per cent.
Manganese	0.25 to 0.45	0.25 to 0.35	0.25 to 0.35
Silicon, not over ...	0.20	0.15	0.12
Phosphorus, not over	0.03	0.020	0.010
Sulphur, not over ...	0.04	0.020	0.010

2. The steel to be crucible steel properly melted in crucibles, not so-called "crucible analysis," with the exception of Grade A, which may be acid open-hearth steel.

3. The steel shall have been sufficiently forged to refine the grain, and forging stopped at such a temperature that the maximum refinement of grain will be obtained.

4. Steel containing the exact minimum amount of carbon in any class will be considered as belonging to the class below.

5. The steel shall be free from flaws and other imperfections.

The 11d. grade of steel was discarded; being an alloy of steel, it could not be included in a carbon-steel specification. A very low grade was added to cover such steel as would be suitable in open-hearth.

Table Giving Class and Grade of Tool Steel for Various Purposes.

	Grade A.	Grade B.	Grade C.
Class 1. 0.75 to 0.85 C.	Drop dies. Dies for hammers in blacksmith shop.	Hammers. Drifts. Punches. Hot chisels.	Cold chisels. Cold sets.
Class 2. 0.85 to 0.95 C.	Cams.	—	—
Class 3. 0.95 to 1.10 C.	Sheet steel for springs.	Lathe centres.	Miscellaneous steel for blacksmith shop.
Class 4. 1.10 to 1.25 C.	Spring (coil).	Springs (spec.).	Miscellaneous steel for die room. Large reamers. Sheet steel for slotting saws. Large dies. Large taps. Letters. Figures. Milling cutters over 2 in. in diameter. Drill rod.
Class 5. 1.25 to 1.40 C.	—	—	Milling cutters 2 in. and under. Small dies. Chasers. Gravers. Dies for heading machines.

The various manufacturers were asked to quote prices on the different grades, which, with one or two exceptions, was done.

* From the "General Electric Review."

MOULDS FOR COOLING ALUMINIUM.—The remarkable thermal conductivity of carborundum has recently received an interesting application in the manufacture of moulds for cooling aluminium, to rapidly chill the cast metal. Aluminium, as moreover, all other metals, becomes much denser when it is cast in a carborundum mould, which rapidly extracts heat from the cast metal. By this there is produced a sort of temper which gives the metal a much finer and denser structure. Sand moulds, on the other hand, being poor conductors of heat, cool the metal very slowly and in consequence allow all the constituents of the metal the time necessary for crystallisation and segregation. The manufacture of these moulds consists, according to the inventor of the process, in dry mixing fine carborundum powder with sugar and clay. The mixture is moistened with sufficient mortar to give a plastic mass to which is given the shape of the desired mould; this is then baked. These moulds also possess the advantage of being much lighter than metallic moulds, and of being readily broken. crushed, reduced to a fine powder and reagglomerated again with a different shape.

F.T.J. Bookshelf.

The Mechanical Engineering of Steam Power Plants.

By Frederic Remsen Hutton, E.M., Sc.D. London: Chapman & Hall, Limited.

To those who are familiar with the earlier edition of this work the extensions and revisions which appear in the present book will be ample evidence of the care and labour that has been expended in bringing it to its present state of excellence; to those who have had no previous acquaintance with the book, we may safely recommend it as one of the most comprehensive treatise on the subject of steam power plants. The object of the book is largely the study of the function and purpose of power-plant apparatus, and it must not be regarded as a treatment of the design of the elements of the power-plant, but only of the power-plant as an aggregate of elements. It is essentially a handbook for the student of engineering, and to have included machine design would have been to seriously hamper its usefulness in its own field. The basis of theoretical mechanics under some elements of power-plant practice has been given in smaller type than the other matter, allowing those to whom it is of only secondary interest to maintain the continuity of the other more applicable parts. It may be suggested that the rapid development of the steam turbine during the last few years, and the development of the internal combustion motor and gas engine, bid fair to greatly modify the value of such a treatise as this, in so far as it relates to the reciprocating engine, but we are quite in agreement with the author in contending that for meeting certain requirements the reciprocating engine will continue to hold its own. Further, everything in the treatise concerning the boiler, the piping, and the auxiliaries would remain equally valuable under any such change. Despite the changes that are continually occurring in mechanical practice, and despite the development of various forms of power-plants, there will long continue to be a wide circle which will welcome such a book as this. The thoroughness with which the compilation has been carried out by the author will ensure it a prominent position among the aids to engineering education. The book has been divided into nine parts, the first containing the introduction and a chapter on the quantitive basis of the steam power-plant. The second and third parts treat with boilers and their accessories, and boiler plant auxiliaries, while the next is devoted to the piping of pressure to the engine and its accessories. Following that, engines, valves, etc., engine auxiliaries, condensers, lubricators, etc., are dealt with, and then is considered the care and management of the plant. General remarks upon power-plant, and a number of appendices conclude the book. It is impossible to here indicate the extent to which the details of these different sections of the subject are brought out; suffice to say that no detail of importance appears to have been overlooked. Illustrations abound throughout the pages, and materially assist the author's text, while the general arrangement of the work is commendable for its convenience. There are several noteworthy features that may be mentioned, such as the treatment of the analysis of the power-plant and its diagram, and the separation between the simple and the complex phases of this problem. The chapters on auxiliaries as distinguished from the essentials, and the chapter on the steam turbine also, are particularly instructive. There are a number of other new and important features, all of which lend additional value to the work.

Enamelling on Iron and Steel.

By Julius Grünwald. Translated by Herbert H. Hodgson. London: Charles Griffin & Company, Limited.

It is only in keeping with the fact that this country has lagged considerably behind both Germany and France in the iron and steel enamelling industry, that this book should emanate from the pen of a German technologist. The subject is one of great interest, both on account of the increasing popularity of enamelled iron and steel ware, the industrial possibilities thus opened up, and the chemical and technical problems involved in its manufacture. This book gives a description of the raw materials that are used in enamelling, and explains the action and the effect of each substance and the chemical combinations that take place. The process of enamelling is followed up in detail from the mixing, melting, and grinding of the enamel components, the annealing and pickling of the sheets and castings, and the application of the enamel to the burning, decorating, etc. A lot of instructive particulars are given which will throw light on many of the difficulties which are encountered in the work of enamelling, and which are frequently not understood. It is interesting to note that until the year 1896 most of the forged metal used in the German works was imported from England; this fact should be gratifying to those who seek to encourage the development of the enamelled-ware industry in this country. It has been proved that we can successfully compete with our foreign friends in the production of at least the better class of enamelled iron and steel, and it appears quite possible that much greater advances will eventually be made in this work by our manufacturers. The dissemination of information on the subject should go a long way to stimulate enterprising men, and as the existing literature on enamelling iron and steel is very meagre, particularly in this country, we are doubly indebted to the translator of this work, who has presented Mr. Grünwald's treatise in so able a manner.

Blast-Furnace Practice.

By J. J. Morgan, F.I.C., F.C.S. London: Charles Griffin & Company, Limited.

To this little work the expression "*multum in parvo*" could very well be applied, for although the extent of the book is only some forty odd pages of matter, it summarises in an excellent manner blast-furnace practice of to-day. It is essentially suitable for the practical man, and to the beginner particularly it should prove valuable, for there is a decided lack of really practical literature on the subject, as opposed to the theoretical treatise. Blast-furnace practice is a difficult subject to treat satisfactorily, on account first of the procedure varying with the raw materials, the class of iron to be produced and local conditions, and also on account of no two furnaces behaving exactly alike. It is well-known that the blast-furnace man must become familiar with the peculiarities of his own furnace in order to get the best from it, but nevertheless he can well profit by information which applies to the work in general. While hard-and-fast lines are difficult to lay down, and, in fact, would be often useless, there is much in blast-furnace practice that is standard. Therefore, this book will be accepted with pleasure by the beginner at the work, the

technical student, the teacher, and the engineer alike. The design and construction of blast-furnaces and plant are not dealt with, the working in every-day practice being the subject. It will be readily appreciated that conciseness is a prominent feature of the book, and if any reader should regret that certain points are not more fully dealt with, he may console himself with the fact that he has at least not had to wade through pages of extraneous matter to arrive at the actual facts and essentials.

The "Mechanical World" Electrical Pocket Book for 1910.

Manchester: *Emmott & Company, Limited*, 65, *King Street*.

The 1910 edition of this excellent little work has undergone considerable revision, and among the new sections that have been introduced are the following:—Motor converters, carrying capacity of cables, cheap house wiring, conduit system of wiring, fuses, electricity metres, time switches, aluminium cables, proportions of cable ends, etc. In the course of revision many new illustrations have been introduced, and the whole brought up to date and improved.

The "Mechanical World" Pocket Diary and Year Book for 1910.

Manchester: *Emmott & Company, Limited*, 65, *King Street*.

The twenty-third yearly issue of this excellent collection of useful engineering notes, rules, tables, and dates has been well revised and improved, and an entirely new section in oil engines has been introduced. A number of other additions have also been made which add to the value of the work.

Correspondence.

Manganese Bronze.

To the Editor of the FOUNDRY TRADE JOURNAL.

SIR,—As one interested in manganese bronze, I write expressing my pleasure to the growing attention it is receiving in the columns of many trade journals, and by the trade in general. This attention is probably due to its increasing use and the resulting difficulties.

The difficulties that are evidenced from time to time however, perhaps ought not to appear to any greater extent than with other yellow metals, if rightly treated. It is true that much has been done in the casting of propeller blades, etc., but particularly when using manganese bronze for castings that are subjected to air and fluid pressures, difficulties present themselves of a very not pleasing character.

Manganese-bronze possesses peculiar characteristics outside other yellow metal alloys, and so requires treatment peculiar to it requirements; the ordinary yellow metal foundry methods will never produce satisfactory results when applied to manganese-bronze. When we consider the innumerable variations in designs, their absence of uniformity, the many sectional thicknesses, also the many angles, faces and parts of castings to be machined, particularly those used in ship-mountings, etc., the specification requiring not only a high ultimate stress but also the castings to stand air and fluid pressures, it will be seen that the founder is called upon to possess the highest qualifications.

Of one thing I am confident, the want of success is due more to the lack of knowledge of the material, and its behaviour under manipulation, than to the lack of ability of the bronze to meet its demands under rightly applied methods, and I am also led to believe that these high-stress bronzes, when their characteristics become better known, will rank pre-eminent among yellow metals. The difficulties at which I have hinted, which are peculiar to manganese-bronze, and can only be overcome by the specific treatment demanded by the bronze, are pipings and general porosity. If we turn for information to one with even an abundance of laboratory experience and a limited knowledge of founding we are disappointed, but if we turn to one with much experience of founding and some metallurgical knowledge that has been accumulated by failures and successes, then many of the difficulties that appear are materially lessened. The ideal founder can, with pattern in the one hand and specification in the other, go into his raw material store, select, and manipulate his material, and construct his mould to meet his requirements with the minimum per cent. of wastage. I am advocating the necessity of a fuller practical knowledge and a closer familiarity with the general behaviour of manganese-bronze under treatment, and this I believe to be imperative to meet not only the general characteristic of the alloy, but also the non-permanency of design. This raises the question of standardisation. To attempt to standardise production apart from repetition work would be a fruitless task. Standardisation is established on the law of uniformity, and castings successfully produced under standardised methods will continue so while the design is in agreement with the methods applied; but if the design be altered, even though the alteration be apparently of a minor character, so closely associated with a vital section of the casting is it that it may render the standard method ineffectual. It is only through a severe schooling and dogged persistence, both practical and theoretical, that a satisfactory measure of success will be attained.

Now briefly, a word on management. The responsible founder should make himself familiar with the components of sets of work etc., as regards the parts to be machined and their various functions. The position of the mould when casting, the locality, and sizes of runner, heads, etc., and the method of casting should be matters of instruction to be imparted through the shop foremen to each man as he receives a fresh piece of work. This may appear to some superfluous, but to leave such important matters entirely to the operator, particularly in foundries where are engaged a number of casually employed moulders who, though excellent mechanics, yet possess little knowledge of bronzes, and who do not see drawings and are not acquainted with the position and function of each piece, does not make for success. Those in charge of such foundries should possess the necessary knowledge and ability to instruct the moulders in every detail.

Again, how much depends upon the furnace and the treatment to the metal in it. For instance, in converting the raw material into ingot form it may receive correct treatment, but when remelted from the ingot the metal may receive very unfair treatment, as by overheating. This means that the first melting operations are wasted, apart from the loss of labour spent on moulding, etc. Again, if in the making of the ingot the material receives bad treatment, then it matters little how well the second melting for casting is carried out; the mischief is

done, and at least a threefold loss is incurred, viz., the first and second meltings, also the cost of moulding, and finally the casting produced, which may fail to meet the specification. Unfortunately, too, this is not always discovered until, perhaps, the casting has been machined prior to testing. Further, the defective treatment may have another effect; when the overheated metal becomes remixed with new or unimpaired material it simply lowers the character of the whole, and often causes further failures in unexpected quarters. I know of no established or sterotyped laws to govern the working of manganese-bronze outside the law of experience; but I believe it is possible with the knowledge of the ultimate stress and percentag of elongation to cater between mould and material so as to produce satisfactory results within certain limits.

Yours, etc.,
F. G. PENNY.

8, Blendon Terrace,
Plumstead Common, Kent.

Queries.

Cupola Particulars.

Can any reader furnish particulars as to how to line a cupola to bring down about 3 tons of metal per hour. The metal is required fairly hot, as the work is light, all the metal being taken away in shanks and hand-ladles. The inside diameter of the cupola is 5 ft. 4 in.; the distance from bottom of the cupola to the charging door 9 ft. 2 in.; the distance from bottom of cupola to the centre of the bottom row of tuyeres 2 ft. 2 in. Would it be wise to fill in with ordinary red bricks between the casing and the fire-brick lining? At present the lining measures 15 in. a side, and is all fire-bricks, which means a very expensive lining. Advice is also desired as to the number of tuyeres and size, and also the shape of lining. We often have trouble with our cupola scaffolding, masses of slag, coke, and iron adhering to the sides above the tuyeres; any hints to remedy the trouble would be appreciated. "A.W.H.C."

Replies.

Cupola Particulars.

In answer to the query by "H.L.F.C.," the following particulars may be useful:—

Metal to be melted	6 to 8 tons per hour.
Outside diameter of cupola ...	5 feet.
Inside " " ...	2 ft. 6 in. to 2 ft. 8 in.
No. of tuyeres	4.
Size of tuyeres (round)	6 in. to 7 in. dia.
" " (oblong)	6 in. to 5 in.

The distance from bottom to centre of tuyeres depends on whether light or heavy castings are produced and may be anywhere between 2 ft. and 3 ft. The distance from tuyeres to charging door should be 15 ft., while the distance from charging door to the top will depend on whether a spark arrester is required. The blower should give from 30,000 to 40,000 cubic feet of air per ton of iron melted, or from 5,000 to 6,000 cubic feet of air per minute. The power required would be 30 h.p., and the diameter of the blast pipe 14 in. by and 15 in.

"U.A."

Inventions.

Applications for Patents.

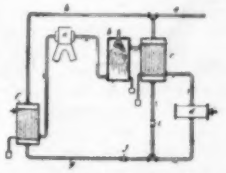
An asterisk indicates that a complete specification accompanies the application. When inventions are communicated the names of the communicators are in brackets.

27,061.*Pattern moulding-machine for pulleys. F. K. Axmann, 56, Myddelton Square, London.
27,132. Melting and casting magnesium and alloys thereof. (Chemische Fabrik Griesheim Elektron, Germany.)
27,600.*Fusion furnaces. L. Rousseau.
27,863. Foundry moulding machines. T. Spiers and E. A. Barringer, Eclipse Foundry, Graham Street, Leicester.
27,972.*Electric furnaces. J. A. Hay.
28,031. Equipment of moulding shops. R. Ellis.
28,229.*Heating furnaces. R. F. Hislop and G. R. Hislop, Jun., Underwood House, Paisley.
28,468.*Metal cores for use in casting hollow bodies. W. Kurze, 37, Furnival Street, London.
28,603.*Furnaces or ovens. G. H. A. Meker.
28,625.*Filters for metallurgical uses. (Harold Binney, United States.)
28,764. Manufacture of cast metal kettles and other utensils. C. F. Clark, Royal London Buildings, Wolverhampton.
28,813. Electric furnaces. E. Wassmer, Norfolk House, Norfolk Street, Strand, London.

Abstracts of British Patent Specifications recently accepted.

23,529 (1908). *Dessication of Air for Metallurgical Operations.* L. Block, Mamaroneck, New York, U.S.A. —The air as it passes to the blowing machine, is caused to pass through a cooler or condenser, in which a large portion of the moisture which it contains will be deposited. The air which passes from the motor driven by the compressed air, or a portion of such air, instead of being passed directly to the stoves or furnaces, is, first of all, passed through the pre-cooler through which the air entering the blowing engine also passes, the compressed air which expands in this pre-cooler serving to cool a series of pipes around or through which the air passing to the compressor flows. The annexed cut illustrates the invention arranged in conjunction with so much of the apparatus as is necessary to enable the same to be understood.

a is the compressor cylinder, *b* a water spray condenser into which the air from the compressor is delivered, and *c* a surface condenser. *d* is the engine which is operated by the expansion of the compressed air and from which the expanded air can pass through the tubes of the surface condenser *c* to the pipe *e* which conveys air to the heating stoves or furnaces.

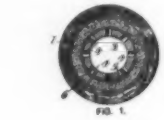


Apparatus for the Dessication of Air for Metallurgical Operations, by L. Block.

f is the surface condenser or pre-cooler, through which the air is drawn into the compressor cylinder *a* passes at atmospheric pressure. The pre-cooler is connected by a pipe *g* with the exhaust side of the engine *d*, so that the cold air from the latter is passed through the tubes of the pre-cooler, and cools the same to condense a considerable portion of the moisture from the

air before it enters the compressor cylinder *a*, the expanded air being conveyed from the pre-cooler *f*, through the pipe *h*, which communicates with the pipe *e*. *i j* are cocks arranged in the pipes connecting the engine *d* with the surface condenser *c* and pre-cooler *f* and the adjustment of which serves to cause the whole of the air which expands in the cylinder *d* to pass through either the condenser *c* or the pre-cooler.

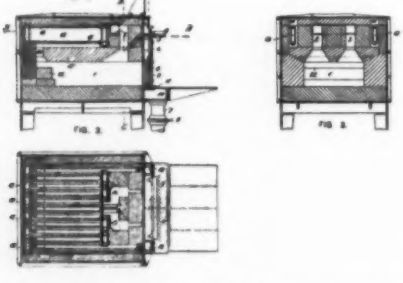
14,141 (1909). *Pipe Cores and Methods of Making the Same.* C. W. McWane, Lynchburg, County of Campbell, Virginia, U.S.A.—Figure 1 is a cross-sectional view of a core constructed in accordance with this invention; Figure 2 is a longitudinal sectional view through a portion thereof. In this core, the usual barrel 3 is employed, which is preferably tubular in form, and is perforated, as shown at 4. This barrel is preferably surrounded by a sheet 5 of holding material, such as cloth or perforated paper, but this sheet is not necessary, its particular object being to



Improved Pipe Cores.

provide a better surface than the metal for holding the inner layer of material. This layer, which is designated 6, is formed of green sand. This coating is applied without a container or covering either directly to the sheet 5, or if the sheet is not used, directly to the outer surface of the core barrel 3. As soon as the coating 6 is applied, an outer coating 7 of loam or other suitable material is applied. After the application of the outer coating 7, the mould is baked or dried in the usual manner. and is then ready for use.

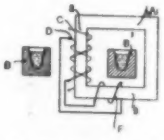
3,747 (1909). *Construction of Oil-fired Furnaces, more particularly Annealing Furnaces.* Schrauben- & Schmiede-Warenfabriks Aktien-gesellschaft Brevillier & Company, and A. Urban & Söhne, of 132, Haupt-strasse, Vienna, XXI/1, Austria.—This invention relates to an oil-fired furnace of the kind in which a number of pipes



Construction of Oil-fired Furnaces, more particularly Annealing Furnaces.

are provided in a chamber arranged above the furnace chamber and directly connected to the latter. The combustion air for the fuel passes through the pipes, which are heated by the combustion gases surrounding them. A feature of the invention is that the ends of pairs of pipes through which the combustion air passes are connected together by a chamber and secured by screw bolts passing through the chamber, whilst a tight joint of the pipes is obtained by the ends expanding on being heated and pressing against an abutment formed by the chamber walls. Fig. 1 is a vertical section through the furnace; Fig. 2 a section on line A—B of Fig. 1; and Fig. 3 a section on line C—D of Fig. 1.

3,599 (1909). *Electrical Induction Furnaces.* C. Grunwald, 116, Essenerstrasse, Bredeney, Prussia.—Upon the part of the transformer yoke which is surrounded by the primary winding, an auxiliary winding is arranged, the ends of which communicate with two points of a limb winding of the transformer yoke, and between which when the furnace is working a tension exists which is directed in opposition to the electromotive force induced in the auxiliary winding and is less than this by such an amount that a current strength is produced in the auxiliary winding which is adequate for the compensation of the electro-dynamic effects which arise between the primary winding and the melting bath. A constructional form of the subject matter of the invention is diagrammatically illustrated in the annexed cut. Around one limb *a* of the transformer yoke A is annularly laid the melting gutter B. Upon the limb *a* is arranged the primary winding C and also an auxiliary winding D. Upon the lower cross bar *b* of the transformer yoke is placed a second auxiliary winding F, which has smaller number of turns than the winding D has. The two windings D and F are so connected with each other that the electromotive forces induced in them, during the working of the furnace, act in opposition to each other. If the primary winding be supplied with an alternating current, there is induced in the melting bath in the melting gutter, a current which always flows in the opposite direction to the current which flows through the primary winding. Repulsional forces are therefore exerted by the primary winding C upon the



Grunwald's Electrical Induction Furnaces.

melting bath, under the action of which the upper surface of the melting bath tends to rise at the outer edge. In the two auxiliary windings D and F are induced electromotive forces which, in consequence of the above described method of connection of the two windings act in opposition to each other. As the number of turns in the winding D is greater than that in the winding F, the electromotive force induced in the winding D preponderates. There is therefore produced in the windings D and F a current the direction of which is determined by the direction of the electromotive force induced in the winding D, that is to say, the current flows in the winding D in the opposite direction to the current flowing through the primary winding, that is to say in the same direction as the current induced in the melting bath. The winding D consequently exerts attractive forces upon the melting bath. By a proper choice of the ratio of the number of turns of the two windings D and F connected with each other it is therefore easy to ensure that the attraction exerted by the winding D upon the melting bath is balanced by the repulsion emanating from the primary winding C. In this case the upper surface of the melting bath remains level even during the working of the furnace, as the winding F occupies such a position that it has no appreciable influence on the equilibrium of the melting bath.

Trade Talk.

NEW works have lately been erected in Queen Square, Leeds, by Jackson's Boilers, Limited.

WE understand that Mr. R. Hutton, of the Foundry, Knottingley, is shortly relinquishing his business.

THE new works at Willesden of the Cowper-Coles Engineering Company, Limited, are now in full operation.

MR. J. J. MORGAN, F.I.C., has established himself in practice as an analyst and metallurgist at the Laboratory, Church Road, Harrington, Cumberland.

MESSRS. P. JENKINS & SONS, of the Excelsior Metal Works, Neath, are about to erect a large extension to their works.

THE Merton Metallurgical Company have removed from 4, Sun Court, Cornhill, to 3, Lombard Street, London, E.C.

MR. C. F. MENDHAM, Consulting Engineer, etc., has removed his offices from 14, Fenchurch Street, to 85, Gracechurch Street, London, E.C.

A RECEIVING order has been made in connection with the affairs of Mr. W. Parsons, engineer and ironfounder, Amhurst Road, Hackney, London, N.E.

THE Council of the University of Sheffield have appointed Mr. A. B. Coward, B.Eng., to the post of demonstrator in the Department of Engineering.

MESSRS. T. H. BROOKER & COMPANY, electrical and mechanical engineers, Gray's Inn Passage, London, W.C., have opened an office at 44, Bedford Row, London, W.C.

MESSRS. C. H. S. NAYLOR AND H. BROADHEAD, electrical engineers, Manchester, trading under the style of C. H. S. Naylor & Company, have dissolved partnership.

MR. A. G. S. BATCHELOR, solicitor, Newport, is negotiating for the setting up in the vicinity of the town a branch of the iron works carried on by a Midland firm.

MESSRS. E. C. BROWN & COMPANY, 4, St. Mary Axe, London, E.C., have been appointed London agents of Messrs. Lawrence & Nicol, City Galvanising Works, Liverpool.

THE estates of J. M. Collins, engineer and machine-maker, 121, Swanston Street, Glasgow, were sequestrated on the 30th November by the Sheriff of Lanarkshire at Glasgow.

MESSRS. WALTER W. COLTMAN & COMPANY, Central Boiler Works, Loughborough, have built new offices adjoining their works and fronting on the main Central Road.

CONSIDERABLE damage was caused by fire recently to the premises of Howell & Company, Limited, steel manufacturers, Brook Lane, Sheffield, a warehouse being partially destroyed.

MR. G. LAYLAND, St. Elmo, Canterbury, Melbourne, has been appointed Australian agent of Messrs. Robert Walber & Company, iron and steel merchants, etc., of Millwall, London E.

MR. G. W. BUNTING 49, Park Avenue, Whitley Bay, has been appointed sole representaive for Newcastle, Middlesbrough and district for Feld Bros. & Company, Limited, of London.

A DISSOLUTION of partnership is notified in connection with Messrs. R. Morris and B. A. Woods, ironfounders, Bradley, Bilston, who traded under the style of Morris & Company.

MESSRS. G. WOOD, A. R. OSBORNE, and G. S. OSBORNE, manufacturers of edge tools, etc., Dronfield, Derbyshire, trading under the style of Wood & Osborne, have dissolved partnership.

MESSRS. J. HALL & SON, Blue Boar Foundry, Rochester, have acquired the whole of the drawings and patterns used by the late firm of Taylor & Neate, Medway Iron Works, Rochester.

MR. JUSTICE SWINFEN EADY, in the Companies Winding-up Court, recently, made a supervision order in the voluntary liquidation of the Jersey Dry Dock and Engineering Company, Limited.

MESSRS. WM. ARNOTT & COMPANY, of the Coatbridge Boiler Works, Coatbridge, have appointed Messrs. Blake & Scott, 41, Old Queen Street, Westminster, S.W., as their London representatives.

THE DISTRICT IRON AND STEEL COMPANY, LIMITED, District Works, Smethwick, Birmingham, have installed a 5-ton platform bar-weighing machine by Ashworth, Son & Company, Limited, Dewsbury.

IN the Companies' Winding-up Court, recently, Mr. Justice Swinfen Eady made compulsory orders for the winding-up of the Phosphor Bronze Company, Limited, and Blundell's London Copper and Brass Works, Limited.

A RECEIVING order has been made in connection with the affairs of Messrs. J. F. Charleton and M. Allen, lately trading in co-partnership under the style of Charleton, Allen & Company, ironfounders, South Shields, Durham.

MR. A. M. CAWOOD, 136, Buchanan Street, Glasgow, has been appointed Glasgow and district representative of Palmer's Shipbuilding and Iron Company, Limited, Jarrow, and the Newport Rolling Mills, Limited, Middlesbrough.

THE duty payable on expansion joints of all kinds, for pipes, imported into the Commonwealth of Australia is now 30 per cent. *ad val.* under the general tariff, and 25 per cent. *ad val.* under the United Kingdom preferential tariff.

THE British Corporation for the Survey and Registry of Shipping, after exhaustive tests, have sanctioned the use of the Thermit process for repairs to fractured sternposts, lower portions of rudder frames, and damages of a similar character in American ports.

THE BLAIR ENGINEERING COMPANY, of New York, makers of the Blair port and bulkhead for open-hearth furnaces, have appointed Andrews, Croucher, & Company, Limited, 62, Queen Victoria Street, London E.C., as their sole agents for the United Kingdom.

THE cutting of steel by means of the oxygen process has made good progress recently in the West of Scotland. A large marine boiler was cut up by this process recently by Messrs. David Tosh & Sons, Greenock, in the yards of Messrs. Russell & Company, Port-Glasgow.

MR. JUSTICE SWINFEN EADY, in the Chancery Division, recently, appointed a receiver and manager and, the company consenting, gave the usual judgment in a debenture-holder's action, in the case of Auld and others against the New Lowca Engineering Company, Limited, and others.

A GENERAL meeting of the shareholders of the Furnace Specialists' Company, Limited, in liquidation, has been called by the liquidator, Mr. James Myles, junr., C.A., 150, Hope Street, Glasgow, to be held at his office on January 17, for the purpose of having an account of the winding-up which has been conducted.

A MEETING of the members of the Society of Engineers was held, recently, at 17, Victoria Street, S.W., when resolutions were passed approving the proposed amalgamation with the Civil and Mechanical Engineers' Society, and authorising the Council to wind-up the Society's affairs.

AN outbreak of fire occurred recently in the engine-house of the Castle Court Foundry, Falkirk, belonging to Falkirk Iron Company. The brigade succeeded in extinguishing the fire, but not before the engine-house had been destroyed, and much valuable machinery damaged.

MR. J. W. STEWART, C.A., 150, Hope Street, Glasgow, the trustee on the sequestrated estates of John Goodwin, a partner of the firm of James Goodwin & Company, engineers and ironfounders, Ardrossan and Motherwell, intimates that a final dividend will be paid to the creditors on January 18.

We understand that Mr. W. A. Colley has been appointed general manager and a director of John Kenyon & Company, Sheffield, Limited, makers of crucible steel, of Sheffield, and that the business of W. A. Colley, Limited, crucible steel makers, Sheffield, except as regards the cutlery department, will be carried on in conjunction with that of John Kenyon & Company (Sheffield) Limited. The cutlery and electro-plate portion of the business of W. A. Colley, Limited, is for sale as a going concern.

The Founders Company is arranging to hold another exhibition (which will be opened by the Lord and Lady Mayoress) in London on June 7 and 8 next year, of castings and models in metals, viz., aluminium, bronze, brass, gold, iron and silver, also of designs in wood, plaster, and any other suitable material for casting to be competed for by founders, designers, craftsmen, apprentices, and improvers, British born subjects engaged in foundry business or its allied trades.

Ashworth, Son & Company, Limited, Midland Iron Works, Dewsbury, have leased an extensive tract of land adjoining their present works, where it is their intention to eventually erect a complete works. Operations have been commenced by building and erecting shop and general offices, and a portion of the old works have been closed down, the foundry in Vulcan Road will, however, be retained, pending the completion of arrangements for the erection of a plant upon the new site.

The annual meeting of the Birmingham Association of Mechanical Engineers was held recently. The chair was taken by the President (Mr. W. Deakin), and there was a large attendance of members. The diploma awarded for the best paper read before the association during the past session was presented to Mr. F. W. Suffield for his paper on "The design and equipment of factory buildings." Mr. H. J. Grant was elected president for 1910, Mr. J. Batey vice-president, and Mr. A. Cooke treasurer. The secretary, Mr. L. O'Brien was re elected for the 21st year.

The Machinery Users' Association's advisers have attended before various Assessment Committees lately, including Wigan, Warrington, Milton, and Middlesbrough, where many cases of importance were dealt with, and the following reductions were obtained in the increased rateable values objected to:—Sir B. Samuelson & Company, Limited, 31.5 per cent. reduction; Tees-side Bridge and Engineering Works, Limited, 56.2; Sir S. A. Sadler, Limited, 57.9; Crewdson, Hardy & Company, 42.5; W. Richards & Sons, Limited, 78.9. In the case of J. Hill & Company (in liquidation), the reduction amounted to 100 per cent.

Application for the registration of the following trade marks is notified in the "Trade Marks Journal":—"The Four Seas" (with device), Callender's Cable and Construction Company, Limited, Hamilton House, Victoria Embankment, London, E.C., Cl. 5, metallic alloys, 314,257; "Barl," Bar Metal Company, Limited, Broad Sanctuary Chambers, Westminster, London, S.W., Cl. 5, malleable iron castings, tool steel, ingots, 314,401; "Speedwell," Thomas A. Ashton, Limited, 26, Norfolk Street, Sheffield, Cl. 50, emery wheels, 316,777; "Cato" Evertito"; "Holdtito"; "Sotito," A. T. Becks & Company, 54, Clement Street, Birmingham, Cl. 5, metal alloys, 317,072-3-4-5; "Velveto," McKechnie Bros., Rotton Park Street, Birmingham, Cl. 5, metals and alloys, 317,148.

The North-Eastern Railway Company were recently called upon to deal with an exceptional consignment in transporting from the works of the Darlington Forge Company to West Hartlepool the cast-steel stern frame, rudder, and brackets which have been manufactured for the "Titanic," now being built by Harland & Wolff, Limited, of Belfast. The total weight of the castings is over 280 tons, the weight of the stern frame castings alone exceeding 70, and for the purposes of transport it had to be made in two pieces. Although loaded upon a special type of 50-ton bogie "well" wagon, the overhang upon one side of the truck was no less than 14 ft. In order to relieve the enormous strain upon the wagon, a steam travelling crane of 25 tons capacity was brought into requisition, and heavy balance weights were fixed on the opposite side of the wagon to afford stability. Both sets of metals on either side of the load had to be requisitioned.

The Government placed numerous contracts during November, those affecting the iron, steel, and engineering industries being detailed below. Mechan & Sons, Limited, of the Scotstoun Iron Works, Glasgow, are to supply the Admiralty Contract and Purchase Department with distributing boxes, and steel wire rope is being supplied by Craven & Speeding Brothers, Monkwearmouth, Sunderland, and Glaholm & Robson, Sunderland. Other contracts awarded include the following:—Admiralty: Director of Works Department—Buckets, steel, for dredgers, J. Rogerson & Company, Limited, Wolsingham, R.S.O., co. Durham; crane, steam, dredging, T. Smith & Sons, Old Foundry, Rodley, near Leeds; dredger, suction, hopper, W. Simons & Company, Renfrew, N.B.; Works Services—Extending machine shop, H.M. Dockyard, Devonport, Dorman, Long & Company, Limited, Middlesbrough. War Office: Destructor, etc., the Horsfall Destructor Company, Limited, Pershore; machine, vertical milling, A. Herbert, Limited, Coventry; nails, horseshoe, Capewell Horse Nail Company, Limited, Glengall Road, Millwall, E.; piping, cast iron, Sheepbridge Coal and Iron Company, Limited, Chesterfield; repairs, alterations, and renewals, including fixing new boilers in s.s. "Lansdowne," Cox & Company (Engineers), Limited, Docks Engine Works, Falmouth; shoes, horse, British and Colonial Horse Shoe and Machine Company, Limited, Billiter Buildings, Billiter Street, E.C.; Vaughan Brothers, Eagle Works, Willenhall; well boring operations and pumping machinery, Woolwich Dockyard, A. C. Potter & Company, 54, Lant Street, S.E. General Post Office: Cable, India-rubber and cotton core, Callender's Cable and Construction Company, Limited, Leigh, Lancs.; Henley's Telegraph Works Company, Limited, North Woolwich, E.; cable, paper core, British Insulated and Helsby Cables, Limited, Prescot, Lancs.; Western Electric Company, North Woolwich, E.; insulators, Doulton & Company Limited, Burslem; pipes, cast iron, Stanton Iron Works, Limited, near Nottingham; screws, coach, Bullers, Limited, Tipton, Staffs.

COMMITTEES OF THE INTERNAIONAL TESTING ASSOCIATION.—The British section of the International Testing Association held a meeting, recently, at which committees were appointed for the investigation of certain subjects. The various committees are now constituted as follows:—A. Metals.—(*a*) Influence of slag enclosures, Mr. J. E. Stead, Dr. W. Rosenhain, and Mr. E. F. Law. (*b*) Determination of hardness by ball or cone-pressure tests (existing problems 2 and 27), Professor Unwin, Professor Goodman, and Dr. Stanton. (*c*) Impact tests, Mr. W. G. Kirkaldy, Captain M. H. Riall Sankey, Mr. Bertram Blount, and Dr. Stanton. (*d*) Method of testing cast iron (problem 25), referred to Committee 1, with following additions:—Mr. J. E. Stead, Mr. F. W. Harbord, Mr. W. G. Kirkaldy, and Mr. E. Adamson. (*e*) Utilisation of magnetic and electric properties of material in connection with the mechanical testing thereof, appointment of nominees to be referred to the National Physical Laboratory. (*f*) International Specifications for Iron and Steel, Committee 1:—Mr. J. E. Stead, Mr. F. W. Harbord, Mr. F. E. Robertson; Committee 1A:—Mr. F. E. Robertson, Mr. Skelton, Professor Goodman, Mr. J. T. Milton, Captain Sankey, Mr. Stead, and a nominee by Mr. H. F. Donaldson and by Messrs. Vickers, Sons & Maxim, respectively. (*g*) Nomenclature of iron and steel (problem 24), Dr. Rosenhain, Mr. F. C. Fairholme, and Mr. L. P. Sidney. (*h*) Specifications for copper alloys (problem 38), Dr. Glazebrook, Mr. F. Tomlinson, Mr. Bertram Blount, Professor Gowland, Mr. J. T. Milton, Dr. Rosenhain, and a nominee of the Institute of Metals.

Personal.

THE gross value of the estate of the late Mr. Alexander Fleming, ironmaster, of Glasgow, is £871,574.

MR. F. P. JONES has resigned his position as general manager of the Dominion Iron and Steel Company, of Nova Scotia.

MR. J. A. FARRELL, president of the United States Steel Products Export Company, is at present this side of the Atlantic.

MR. CHARLES KIRCHHOFF, after nearly 30 years' service, has decided to retire from the editorial management of the "Iron Age."

MR. F. A. YERBURY has been elected managing director of the Canadian Boring Company. He sails for Toronto early this year.

MR. J. E. COOPER, manager of the works of Simpson, Strickland & Company, Limited, Dartmouth, has been elected a director of the company.

MR. WILLIAM P. C. BAIN, of Messrs. William Bain & Company, Lochrin Iron Works, Coatbridge, has been admitted a member of the Edinburgh Merchant Company.

THE Council of the Institution of Civil Engineers has placed a stained-glass window in Westminster Abbey to the memory of Sir Benjamin Baker, a past president of the Institute.

THE late Mr. E. D. Crane of the Crane Foundry Company, Limited, of Wolverhampton, and the Wellingborough Iron Company, Limited, left estate valued at £29,440 gross, with net personalty £25,470.

THE late Mr. A. McGregor, managing director of Messrs. Harrison, McGregor & Company, agricultural engineers and implement makers, left estate of the gross value of £26,899, with net personalty £24,965.

THE directors of the Midland Railway Company last month appointed Mr. H. Fowler, chief mechanical engineer; Mr. A. J. Owen, superintendent of operations; and Mr. L. C. Geach, superintendent of motive power.

THE southern divisional engineership of the Midland Railway has now been divided. For the future there will be a southern and western division, and the directors have appointed Mr. H. P. Miles and Mr. F. H. Frere respectively.

MR. G. THOMSON has been appointed general manager of the Australian business of Stewarts & Lloyds, Limited, in place of Mr. J. Brown, retired. Mr. Thomson has been N.S.W. manager of the firm for the past fourteen years.

MR. D. R. MAYHEW has resigned his position as branch manager to Willans & Robinson, Limited, in order to take up the position of general manager to Messrs. Michael Pal & Company, Engineers, Westminster London, S.W.

MR. MYLES KENNEDY, chairman of the North Lonsdale Iron and Steel Company, Limited, recently celebrated his "coming of age" as a director of the company, having been re-elected to that position continuously since the year 1888.

THE late Mr. J. R. Robinson, of Smithfield, Zetland Road, Loftus, senior partner in the firm of Messrs. Robinson Brothers, ironfounders and implement makers, Loftus-in-Cleveland, left estate totalling to £2,757 1s., of which £824 11s. 2d. is net personalty.

MR. ROBERT MATTHEWS, of Sir W. G. Armstrong, Whitworth & Company, Limited, and president of the Manchester District Engineering Trades Employers' Association, has been elected a member of the Council of the Institution of Mechanical Engineers.

MR. E. J. LJUNGBERG, of the Stora Kopparberg's Bergslags Company, who was recently elected an honorary Vice-President of the Iron and Steel Institute in London, was made an honorary Doctor of the new University at Stockholm on the occasion of its inauguration on December 6 last.

MR. F. W. HARBORD, of Edward Riley & Harbord, 16, Victoria Street, Westminster, London, S.W., has arrived in South Africa. He has gone direct to the Transvaal to report for the Government on the general metallurgical position on the Rand. He will be occupied on this work for some few weeks, but will probably be back in England some time this month.

MR. W. EDENBORN AND MR. M. HUGHITT have been succeeded in the directorate of the United States Steel Corporation by Messrs. P. Roberts, of Philadelphia, and S. Mather, of Cleveland. Mr. Roberts was at one time president of the American Bridge Company, and Mr. S. Mather is the head of the firm of Pickands, Mather & Company, Cleveland, U.S.A., and a director of the Lackawanna Steel Company.

MR. GEORGE WESTINGHOUSE has been elected president of the American Society of Mechanical Engineers. Mr. Westinghouse was born in 1846 at Central Bridge, New York. He had a natural bent for mechanics which he developed in his father's machine shop, inventing a rotary engine when only 15 years of age. His greatest invention, and the one by which he is best known, was the air brake which bears his name. He was a pioneer in introducing alternating current machinery in the United States.

Deaths.

MR. J. SMITH, a director of John Smith, Limited, crane makers, Keighley, died recently, aged 45 years.

MR. P. E. RICHARDS, of Messrs. Thos. Richards & Sons, ironfounders, St. Philip's, Bristol, died recently, aged 37 years.

MR. G. JACKSON, of Messrs. J. Jackson & Sons, Derdale Iron Works, Todmorden, died recently, aged 60 years.

CAPT. T. G. BUSH, one of the best known iron manufacturers of the Southern States, died on November 11 last at Birmingham, Ala., U.S.A.

MR. R. F. MARTINEAU died at Birmingham last month, at the age of 78. He was connected with the firm of Messrs. Martineau & Smith, brassfounders.

MR. J. H. WYNN, managing director of Wynn, Timmins & Company, Limited, Century Works, Commercial Street, Birmingham, died recently, aged 43 years.

MR. A. F. JONAS, of Sheffield, died recently at the age of 53 years. The deceased was a director of Messrs. Eadon & Sons, Limited, Sheffield, and was originally manager of the works of Askham Brothers & Wilson, Limited.

COLONEL CHARLES GRAYSON, V.D., who died in Liverpool, on December 6, aged 64, was managing director of the shipbuilding and repairing firm of H. and C. Grayson, Limited, which was founded in the 18th century, and is said to have been one of the first to introduce iron shipbuilding.

MR. WILLIAM METCALF, of Pittsburg, formerly of the Crescent Steel Company, died recently. On the organisation of the Crucible Steel Company of America his firm was merged in that company, and in 1895 he started a new crucible steel company, named the Braeburn Steel Company, of which he was president up to the time of his death.

MR. EDWARD TANGYE died at the Manor House, Knowle, recently, at the age of 77. The deceased gentleman was the fourth son of Joseph Tangye, and brother of Mr. George Tangye, Heathfield Hall, Handsworth. He was born at Illogan, Cornwall, on April 27, 1832, and was one of the five brothers Tangye who among them founded and carried on the now world-wide known Cornwall Works. Here, in the early days, he took an active part in the mechanical department of the rapidly developing business, but after a few years was compelled by a breakdown in health to retire.

MR. G. W. HAWKSLEY, founder of the firm of Messrs. Hawksley, Wild & Company, Brightside Boiler Works, Sheffield, died recently. Born on November 17, 1836, Mr. Hawksley was the son of Mr. William Hawksley

joiner and contractor, of Pye Bank. He was apprenticed to his uncle, Mr. George Hawksley, a millwright, at Owlerton, who carried on a business which for generations had been in the hands of the Hawksley family, and had gained a considerable connection in and around Sheffield. Later he went to Mr. Daniel Adamson, who had a noted boiler works at Hyde, near Manchester, and here he secured much of that business knowledge and capacity which stood him in good stead in later years.

THE death occurred at his London residence recently of Dr. Ludwig Mond, well known in the scientific world for his achievements in chemical research, and the managing director of Brunner, Mond & Company, Limited, alkali manufacturers. Dr. Mond, who was 70 years of age, founded and endowed the Davy-Faraday Research Laboratory at the Royal Institution, of which he was vice-president. Another question to which Dr. Mond applied himself was that of the economical utilisation of fuel; and the outcome of his work on this subject, which began about 1879, was the invention of the system of producing power-gas known by his name. Many experiments were also made by Dr. Mond in the hope of utilising Grove's gas battery for the production of electricity on an industrial scale; and though they did not enable him to achieve success in this particular object, they incidentally led him to the discovery of a valuable process for the extraction of nickel from its ores.

BIRMINGHAM FOUNDRYMEN'S VISIT TO JAMES FARLEY & SONS' WORKS.—About 40 members of the Birmingham Branch of the British Foundrymen's Association, on Tuesday, November 30, paid a visit to the iron and steel rolling mills of Messrs. James Fairley & Sons, Dartmouth Street, Birmingham. This establishment has the distinction of possessing the only Siemens-Martin plant in the city of Birmingham, with open-hearth furnace, casting pit, and the necessary electrical equipment all complete. The furnace has a capacity of 12 tons, and the day and night shift produce a total output of about 20 tons, the product being utilised for a great variety of purposes in connection with typical Birmingham industries, such as motor building, cycle machinery, taps and dies, high-class coach work, and various forms of steel-cutting tools. The casting pit is furnished with a 20-ton lifting crane, and the furnace is heated with producer gas. The ingots are manipulated by a 21-in. cogging mill fitted with a moving platform for raising the metal to the upper roll, and the billets are hammered out to various shapes by small steam hammers, of which there are seven, which are kept pretty constantly at work. The hammers vary in weight from three cwts. to a ton. One of the mills is capable of producing bars varying in size from 3-16ths of an inch to 3 in. This is largely devoted to the production of coach-spring steel. The forge and mill plant also deals with a considerable amount of high-speed tool-steel imported from the Sheffield establishment belonging to the same firm. Even in these comparatively dull times, the place appeared to be a hive of industry, and its serviceableness to a considerable variety of Birmingham trades is very obvious. The visitors witnessed the pouring and casting of 10 tons of steel into 32 ingots, which was very successfully done. Parties were conducted round the place by Mr. James Fairley, one of the proprietors, who pointed out that the pressure of space had necessitated some little crowding of plant, but the destruction of a neighbouring flour mill by fire some years ago placed a little more land at their disposal. Possibly it might be found necessary, when the opportunity offered, to transfer the establishment to the rural fringe of Birmingham, where more area would be available. At the close of the visit, a hearty vote of thanks was accorded the firm, on the proposition of Mr. G. Hailstone, seconded by Mr. Gale. The compliment was acknowledged by Mr. Fairley, who expressed the hope that on a future occasion there might be a still better plant to show to the foundrymen.

Legal.

Dangers of Ferro-Silicon.

At the West Riding Assizes, at Leeds, last month, before Mr. Justice Walton, sitting without a jury, an action was heard in which the widow of W. Moxon Bamfield, sued the Goole and Sheffield Transport Company for damages in connection with the death of her husband and illness to herself, alleged to have been due to a breach of contract on the part of the defendants.

Bamfield was the owner of a canal boat, and it was alleged that his death was caused by poisonous gases emanating from casks of ferro-silicon, which were being carried from Goole to Sheffield, to the order of defendants, in October, 1908.

J. A. Foster, County Analyst for the East Riding, said he had examined a sample of the ferro-silicon carried. This substance evolved certain highly poisonous gases. He found that 0.23 grammes were evolved from 160 grammes, this being equivalent to 500 cubic centimetres of gas by measure. In that gas phosphuretted hydrogen predominated. Small quantities of added moisture caused the gas to increase. It was a decidedly unsafe substance to carry on the barge. If he had 10 tons on board, and someone sleeping in the cabin without proper ventilation, he would expect to find them dead in the morning. The gas was heavier than air, and so would remain low down in the barge. He had no doubt that the deceased died from the gases evolved from the ferro-silicon. Peculiar symptoms were the metallic taste, garlic smell, and great thirst of the sufferers. They were in a dilemma with regard to this substance, because if put in air-tight iron casks it might explode, and in wooden casks there was a danger of gases being evolved. It had been known to be dangerous since 1907.

Mr. Tindal Atkinson said he hoped to prove that the defendants had no reasonable means of knowing that this stuff was dangerous.

George Campsall, foreman for the defendant's company at Goole, described how the 31 casks of ferro-silicon were dealt with in transporting them to Sheffield. Witness sat about half an hour with the mate when he was ill, but noticed no smell and felt no ill effects. During the whole time he had been at Goole he had never heard that ferro-silicon was dangerous.

The Judge said that he had come to the conclusion that the casks of ferro-silicon were dangerous, that no notice was given to Bamfield of their dangerous nature, and that damage in consequence ensued. He therefore held that the plaintiff had made out her case. He awarded her £150 damages in respect of the illness to herself, and £175 in respect of the death of her husband.

A stay of execution was granted, pending a possible appeal.

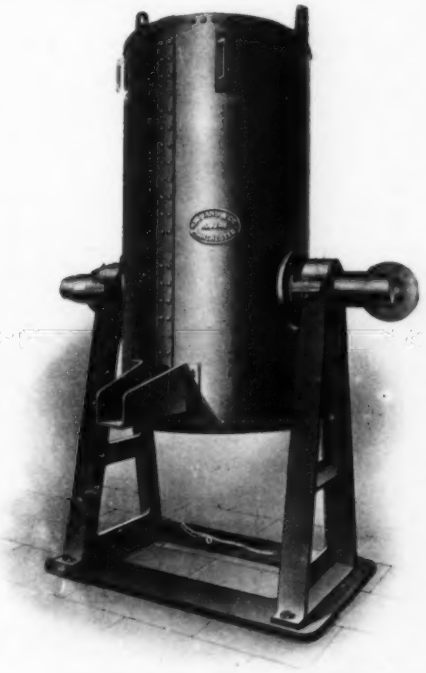
THE Council of the Institution of Civil Engineers have made the following awards for the year 1908-1909:—Telford Gold Medals to Prof. B. Hopkinson, M.A., B.Sc. (Cambridge), and Mr. G. R. G. Conway (Monterrey, Mexico); Watt Gold Medals to Messrs. D. A. Matheson (Glasgow), and W. C. Popplewell, M.Sc. (Stockport: George Stephenson Gold Medals to Messrs. E. H. Tabor (London), and A. J. Knowles, B.A. (Cairo); the "Indian" Premium and a Telford Premium to Mr. T. R. Nolan, B.E. (India); Telford Premiums to Messrs. S. J. Reed (Newcastle), C. T. Purdy (New York), L. A. B. Wade (Sydney), G. Hobbs (Accra, West Africa), W. Cleaver (Port Talbot), J. D. W. Ball (London), Prof. A. H. Gibson, D.Sc. (Dundee), and B. D. Gwyther, M.Sc. (Buenos Aires); the "James Forrest" Medal and a Miller Prize to Mr. J. A. Wotherspoon (Glasgow); the Miller Scholarship to Mr. J. A. Orrell (Manchester); the "James Prescott Joule" Medal and Miller Prizes to Messrs. W. E. Fisher and E. B. Wood (London); Miller Prizes to Messrs. W. E. R. Gurney (London), E. G. L. Lovegrove (London), J. Purser (Birmingham), G. C. Minnitt (Manchester), S. F. Deacon (Manchester), C. H. Bradley, and A. E. Marshall (Birmingham).

AS SUPPLIED TO THE ADMIRALTY, WAR OFFICE,
COLONIES, AND FOREIGN GOVERNMENTS.

THE Cupola.
Evans's Rapid.

Foundries Completely Furnished.

EVANS'S NEW CUPOLETTE
For Emergency Work.



Telegrams: "LADLES, MANCHESTER."

James Evans & Co.
Britannia Works,
Blackfriars,
MANCHESTER.

New Companies.

METALLIC MANUFACTURING COMPANY, LIMITED.—Capital £2,000 in £1 shares, to carry on the business of merchants, engineers, etc.

HEATON & DUGARD, LIMITED.—Capital £40,000 in £1 shares, to take over the business of metal rollers and wire drawers carried on in Birmingham as Heaton & Dugard.

VILLANUEVA COPPER COMPANY, LIMITED.—Capital £12,000 in £1 shares, to acquire an option to work certain properties in Spain. Registered office: 2, Commercial Street, Leith.

HYDEPARK FOUNDRY COMPANY, LIMITED.—Capital £20,000 in £10 shares, to acquire the business of the Hydepark Foundry Company. Registered office: 54, Finnieston Street, Glasgow.

JAMES HOWORTH & COMPANY, LIMITED.—Capital £2,000 in £1 shares, to carry on the business of heating and ventilating engineers, etc. Registered office: Victoria Works, Stockton Street, Farnworth.

JOHN WRIGHT (FENDERS), LIMITED.—Capital £3,500 in £1 shares, to carry on the business, in Birmingham or elsewhere, of manufacturers of and dealers in fenders and other brass, iron, copper, steel, etc.

ROMANALUM, LIMITED.—Capital £500 in £1 shares, to carry on the business of mechanical engineers, machinists, etc., and to adopt an agreement with C. J. Allday, G. W. Dawes, and K. Cramp.

LAMBERT BROTHERS (WALSALL), LIMITED.—Capital £50,000 in 4,000 shares of £10 each and 2,000 shares of £5 each, to take over the business of engineers and tube makers carried on at Walsall as Lambert Brothers.

ROBEY & COMPANY (SOUTH AFRICA), LIMITED.—Capital £7,000 in £1 shares, to sell, lease, or otherwise dispose of, use, or deal in the manufactures of Robey & Company, Limited, engineers, Lincoln, and to act as general agents.

D. BRIDGE & COMPANY, LIMITED.—Capital £25,000 in £1 shares (16,000 5 per cent. cumulative preference), to take over the business carried on at Castleton Iron Works, Castleton, near Manchester, as David Bridge & Company.

LEWIS ENGINEERING COMPANY, LIMITED.—Capital £5,000 in £1 shares, to acquire Patent No. 11,848, of 1909, and to carry on the business of manufacturers of speed indicators etc. Registered office: 5, Moorgate Station Buildings, London, E.C.

GILES FOUNDRY COMPANY, LIMITED.—Capital £15,000 in £1 shares (10,000 preference), to acquire the undertaking of the Giles & Ward Foundry Company, Limited, (incorporated in 1908), and to adopt an agreement with the old company and the liquidator thereof.

WILLIAM COOKE & COMPANY (NOTTINGHAM), LIMITED.—Capital £6,000 in £1 shares, to acquire the business carried on at Haslam Street, Castle Boulevard, Nottingham, to adopt an agreement with C. Cooke, and to carry on the business of ironfounders, engineers, etc.

VERNON ENGINEERING AND CARRYING COMPANY, LIMITED.—Capital £15,000 in £1 shares, to acquire the business carried on by F. M. Birtill at the Vernon Works, Longsight, Manchester, as the Vernon Engineering Company. Registered office: 44, Brazennose Street, Manchester.

WERRY ENGINE SYNDICATE, LIMITED.—Capital £5,000 in £1 shares, to adopt an agreement with W. C. Werry, on behalf of the Werry Engine Company, Limited, of Melbourne, Australia, and to carry on the business of manufacturers and dealers in engines and accessories. Registered office: 31, Lombard street, E.C.

CLADOR SYNDICATE, LIMITED.—Capital £4,200 in 4,000 shares of £1 each, and 4,000 shares of 1s. each, to adopt an agreement with A. A. Lockwood, and to carry on the business of smelters, refiners, reducers, crushers, purifiers, amalgamators, and dealers in ores, etc. Registered office: 55-56, Bishopsgate Street Within, E.C.

SILICAWARE, LIMITED.—Capital £63,000 in £1 shares, to acquire interest in any patents relating to processes and apparatus for melting, and electric furnaces, and for electrical fusing, etc., to adopt an agreement with Dr. Wolf-Burckhardt, and others, and to carry on the business of manufacturers of, and dealers in, such furnaces, etc.

HARTLEPOOL ROLLING MILLS COMPANY, LIMITED.—Capital £15,000 in £1 shares (7,500 preference), to take over the business of the Hartlepool Rolling Mills, West Hartlepool, to adopt an agreement with E. Waring and J. W. Lomas, and to carry on the business of manufacturers, rollers, tilters, and forgers of iron, steel, and other metals, etc.

SILICON METAL is now produced at the plant of the Carborundum Company, U.S.A. Ten years ago metallic silicon or silicon metal was a comparatively rare substance and was classed as a laboratory curiosity; by the close study of the science of its manufacture and by use of the electric furnace, the Carborundum Company has placed it among the commercial metals and made it available for practical use. Its chief use is in the refining of steel, and it is of practical economy to the foundryman and steel maker in that it produces quicker and better results in making dense castings. An analysis of the 90 per cent., or most popular, grade of silicon metals is as follows:—Silicon, 90.60 per cent.; iron, 6.70 per cent.; manganese, 0.08 per cent.; aluminium, 2.35 per cent.; phosphorus, 0.02 per cent.; carbon, 0.22 per cent.; sulphur, 0.00 per cent. From this analysis it will be noted there is an entire absence of the highly objectionable impurity sulphur and it contains over 2 per cent. of aluminium, which is a powerful deoxidising agent. Although used principally by steel makers, it is destined to have a large field when alloyed with other metals.

GANISTER, CUPOLA BLOCKS, FIRE BRICKS,
FIRE CLAY.
Silica Bricks, Tuyeres, Stoppers, Nozzles, &c.
STEEL MOULDERS' COMPOSITION, SILICA CEMENT.
J. GRAYSON LOWOOD & Co., Ltd.,
DEEPCAR, nr. SHEFFIELD.
Telegrams: "LOWOOD, DEEPCAR."

SOUND

STRONG, CLOSE-GRAINED

CASTINGS

Obtained by using

"TITANIUM THERMIT"

TINS READY FOR USE. **ALL SIZES** from 2 cwt. to 20 tons.

Prices and Particulars from

THERMIT LIMITED,

Telegrams: "FULMEN, LONDON."
Telephone: 3749 Central.

27, Martins Lane,
Cannon Street, E.C.

Works: **210a, Bow Rd., E.**

ELDERS FOUNDRY COKE

AS SUPPLIED TO THE BRITISH ADMIRALTY DOCKYARDS.

The following, selected from numerous letters, are eminent testimony as to the quality of our celebrated "A.A.A." Coppee Foundry Coke, carefully selected, and despatched in sheeted wagons.

From PECKETT & SONS, Bristol.

Bristol, October 25th, 1904.

We have been using your Selected Foundry Coke for some considerable time.
We have pleasure in stating that we are very pleased with it, as we find we get sounder and cleaner castings, more free from blowholes and other defects, than we formerly did.

From BOW, McLACHLAN & CO., LTD. (Paisley Foundry), Paisley, Glasgow.

Paisley, 12th March, 1909.

We have yours of 4th inst., and in reply have pleasure in stating that we have been using your Foundry Coke for several years for special purposes with highly satisfactory results.

Elders Navigation Collieries, Ltd., Cardiff.

PRICES OF METALS.

The following table shows the approximate latest prices and position of stocks of metals during the past two years:—

Metals.	End Dec., 1909.	End Dec., 1908.
Iron—Scotch pig warrants ton	*57/3	*55/3
—Middlesbro' warrants .. ton	57 3	49 2
—W.C. M/nos Bessemer ... ton	63 6	58.6
—Stock, Scotch ... .. tons	1,000	1,000
Copper—Chili bars, GMB ton	£61 10 0	£63 15/0
—Stock, Europe and afloat tons		53,634
Tin—English ingots ... ton	...£152 10 0	£132 5/0
—Straits ... ... ton	£153 10 0	£132 5/0
—Stock, London, Holland, U.S.A., and afloat ...tons	—	20,544
Lead—English pig ... ton	£14 0 0	£13 8 9
Spelter—Ord. Silesian ... ton	£23 5 0	£21 0 0
Quicksilver (75lb)... bottle	£9 17 6	£8 10 0
Antimony—Regulus .. ton	£30 0/0	£32 10/0 £33 10/0

* Settlement price.

Castings.

In the Cleveland district the following are the nominal rates current for castings:—

	£ s. d.		£ s. d.
Columns (plain)	6 10 0	to	6 15 0
Pipes, 1½ to 2½ in.	4 17 6	to	5 2 6
,, 3 to 4 in.	4 10 0	to	5 0 0
,, 5 to 8 in.	4 7 6	to	4 10 0
,, 10 to 16 in.	4 7 6	to	4 10 0
,, 18 to 24 in.	4 7 6	to	4 10 0
Chairs	3 10 0	to	3 12 6
Floor plates (open sand)	3 2 6	to	3 5 9

Scrap.

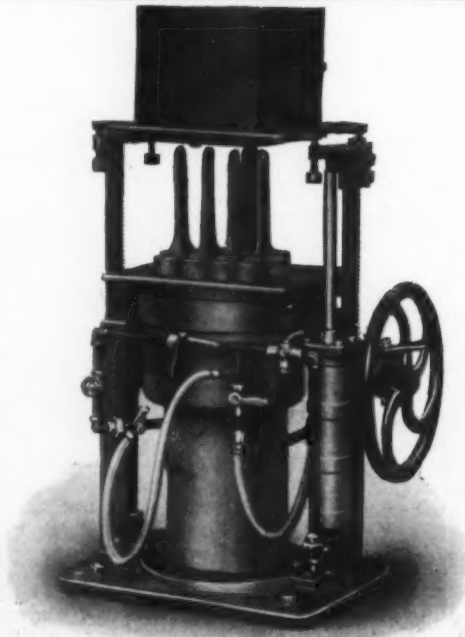
The quotations for scrap, subject to market fluctuations, are as follows:—Heavy wrought (mixed), £2 8s. 0d.; light wrought, £1 1s. 0d.; heavy cast, £2 7s. 0d.; all per ton f.o.b., London. Copper (clean), £55 0s. 0d.; brass (clean), £39 10s. 0d.; lead (usual draft), £12 10s. 0d.; tea lead, £11 10s. 0d.; zinc, £19 0s. 0d.; all per ton delivered merchant's yard.

Messrs. J. Miller and M. Miller, engineers, Paul Street, Finsbury, E.C., trading under the style of I. Miller & Company, have dissolved partnership.

The Central Iron Works, Newport, previously in the occupation of W. A. Baker & Company, Limited, were sold by auction at Newport, on December 7, the purchaser being Mr. Charles D. Phillips, of Emlyn Works, Newport, who also purchased most of the machinery and plant, fixed and otherwise.

As confusion is being occasioned by the recent registration of a company under the style of Metals and General, Limited, the Metal and General Agency, 5, Whittington Avenue, E.C., intimate that they are in no way connected with this company. In consequence of their appeal against this title being used, steps have been taken to alter the name of Metals and General, Limited.

The Highways Committee of the London County Council have recommended that the tender of Hadfield's Steel Foundry Company for special track work in connection with the proposed tramway from Woolwich to Eltham be accepted. Messrs. Hadfield's tender is for £113 15s., as against £122 by Edgar Allen & Company. The Committee propose to at once invite tenders for the supply of track rails and fastenings, slot rails and conductor tees to the value of £30,000.



"HERMAN"

PNEUMATIC JARRING

MOULDING MACHINE,

BRITISH MANUFACTURE.

This Machine will make perfect deep or shallow moulds in a few seconds.

. NO R MING OR PRESSING. .

IN U E ALL OVER THE WORLD.

WRITE FOR PARTICULARS.

PNEUMATIC ENGINEERING APPLIANCES Co., Ltd.,

Palace Chambers, Westminster, LONDON, S.W.

Established 1863.

JAS. DURRANS & SONS,

PHŒNIX WORKS, PENISTONE, Near Sheffield.

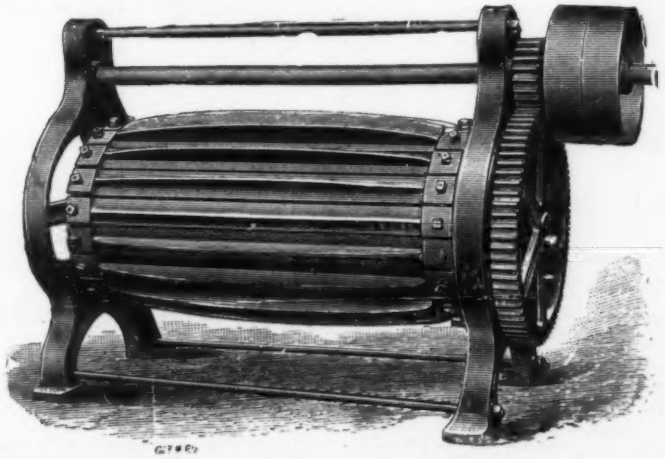
Manufacturers of all

FOUNDRY EQUIPMENTS,

COMPOSITION BLACK LEAD, PLUMBAGO, CORE GUM, WHITE DUST & COAL DUST.

Ladles, Cupolas, Fire Bricks, Gannister, Stone Flux, Loam and Sand Mills, Casting Cleaners, Studs, Chaplets, Pipe Nails, Sprigs, Brushes, Wire Brushes, Core Ropes, Bellows, Buckets, Spades, Forks, Riddles, Sieves, Barrows, Etc.

IMPROVED FOUNDRY RATTLER or FETTLING DRUM.



These Machines are invaluable for a Foundry, doing a larger amount of work of a superior quality, in a much shorter time than can be done by hand, without skilled labour.

"Dear Sirs,—We have been using your best Blacking for a large number of years, and always use it on our large Ingot Moulds, which, as you know, we have made up to 85 tons in weight.

Yours faithfully, THE BRIGHTSIDE FOUNDRY & ENGINEERING CO., LD."

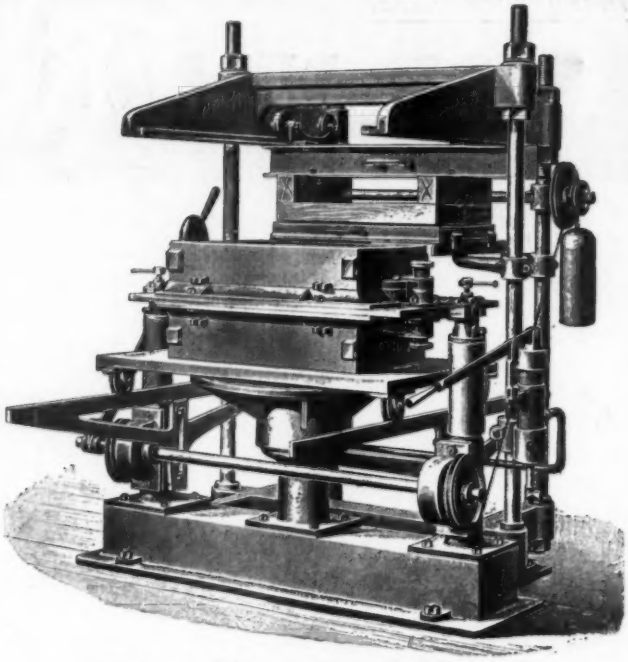
The

Result

OF

Efficiency!

"WE HOPE TO REQUIRE ONE OR TWO MORE."



Hydraulic Turn-over Moulding Machine.
Made in all sizes from 16 in. by 12 in. to 84 in. by 84 in.

Repeat Orders are not given for inefficient machines.

Our machine works and works all the time. No breakdowns!

Read what the customers say:

"Replying to your favour of yesterday, the Hydraulic Moulding Machine is working satisfactorily, and we hope later on to require one or two more."

They have since ordered them.

Our Machines deal with a large range of work, will you let us quote you?

Emery Grinding Machines.

Abrasive Wheels.

The London Emery Works Co. PARK, TOTTENHAM, LONDON, N.

THE BUYER'S GUIDE

Addresses and further information will be found by reference to the Firm's Advertisement.

Abrasive Wheels.
London Emery Works Co.
Jackman, J. W., & Co., Ltd.

Air Compressors.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Electrically Driven).
Jackman, J. W., & Co., Ltd.
Marshall & Co. Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Steam).
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Air Compressors (Belt).
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Tilghman's Patent Sand Blast Co., Ltd.

Annealing.
Phillips, J. W. & C. J.

Ash Crushing and Washing Machines.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Barrels (Tumbling).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P., & Co.
Phillips, J. W. & C. J.
Sonnenthal, Selig, & Co.
Tilghman's Patent Sand Blast Co., Ltd.

Barrows.
Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.

Bellows.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Durrans, Jas., & Sons.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.

Blacklead.
Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Blowers.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Buffalo Forge Co., Ltd.
Davies, T., & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P., & Co., Ltd.
Phillips, J. W. & C. J.
Samuelson & Co., Ltd.
Sonnenthal, Selig, & Co.
Thwaites Bros., Ltd.
Ward, T. W., Ltd.

Buffing and Polishing Machines.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Sonnenthal, Selig, & Co.

Casting Cleaners.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Pneumatic Engineering Appliances Co., Ltd.
Tilghman's Patent Sand Blast Co., Ltd.

Cement.
Dyson, J. & J.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Lowood, J. Grayson, & Co., Ltd.
Marshall & Co., Horace P.
Olsen, Wm.
Plasti-Kion Co.
Silent Machine and Eng. Co.

Chaplets and Studs.
Bush, Henry C.
Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Motherwell, Wm., & Co.
Olsen, Wm.
Wilkinson, T. & Co., Ltd.

Charcoal.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Walker, I. & I.

Charging Platforms.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davies, T., & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Thwaites Bros., Ltd.

Coal Dust.
Cumming, Wm., & Co., Ltd.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Coke (Foundry).
Elders Navigation Collieries.

Coke Breakers.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W., & C. J.

Core Boxes.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Olsen, Wm.

Core Compounds.
Bush, H. C.
Cumming, Wm. & Co., Ltd.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W. & Co., Ltd.
Olsen, Wm.
Wilkinson, Thos. & Co.

Core Gums.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Core Making Machines.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Jones and Attwood.
London Emery Works Co
Marshall, H. P. & Co.
Phillips, J. W. & C. J.

Core Ovens.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J. & Co.
Hislop, R. & G.
Jackman, J. W. & Co., Ltd.
London Emery Works Co.
Phillips, C. D.
Phillips, J. W. & C. J.

Core Ropes.
Bush, Henry C.
City of London Wood Wool Co.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Wilkinson, T. & Co.

Core Vents.
Bush, Henry C.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.

Cranes.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Jackman, J. W., & Co., Ltd.
Vaughan & Son, Ltd.
Ward, T. W., Ltd.

Crucibles.
Hall, Charles, & Co.
Olsen, Wm.

Crucible Furnaces.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
Simplex Coke Oven and Engineering Co., Ltd.

Crucible Furnaces (Lift-out)
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Phillips, J. W. & C. J.

Crucible Furnaces (Tilting)
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Crushing Mills.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Simplex Coke Oven and Engineering Co., Ltd.

Cupolas.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davies, T. & Son.
Durrans, J. & Sons.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
London Emery Works Co.
Marshall, H. P. & Co.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.

Cupola Linings.
Evans, J., & Co.
Harris & Pearson.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.

Emery Grinders.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davis, T., & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.

Emery and Glass Cloth and Glass Paper.
London Emery Works Co.

Emery Wheels.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.

Fans.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Buffalo Forge Co.
Davies, T. & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Jenkins, W. J. & Co., Ltd.
Phillips, J. W. & C. J.
Sonnenthal, Selig, & Sons.
Thwaites Bros., Ltd.

Firebricks.
Durrans, J. & Sons.
Dyson, J. & J.
Harris & Pearson.
Jackman, J. W., & Co., Ltd.
King Bros.
Lowood, J. Grayson, & Co., Ltd.
Pearson, E. J. & J.
Silica Firebrick Co.

Foundry Blacking.
Bush, Henry C.
Cumming, Wm. & Co., Ltd.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Olsen, Wm.
Walker, I. & I.
Wilkinson, Thos. & Co., Ltd.

Foundry Brushes.
Bush, Henry C.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, C.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Phillips, J. W. & C. J.

Foundry Ladles.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Bush, Henry C.
Davies, T. & Son.
Durrans, J., & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P., & Co.
McNeil, Chas.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.

Foundry Rattlers or Fettling Drums.
Alldays & Onions
Davies, T., & Son.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Simplex Coke Oven Co. and Eng. Co., Ltd.

THE BUYER'S GUIDE.—*Continued.*

Foundry Sand.
Dyson, J. & J.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Wilkinson & Co., Thos., Ltd.

Furnaces (Annealing).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Hislop, R. & G.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Furnaces (Brass).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Furnaces (Melting).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davies, T., & Son.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Simplex Coke Oven and Eng. Co., Ltd.

Ground Gannister.
Durrans, J., & Sons.
Dyson, J. & J.
Evans, J., & Co.
Lowood, J. Grayson, & Co.
Silica Firebrick Co.
Walker, I. & I.

Grinding Machines and Tools.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Sonnenthal, Selig, & Co.

Hammers (Steam).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Thwaites Bros., Ltd.

Hay Band Spinning Machines.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.

Hoists.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Davies, T., & Son.
Jackman, J. W., & Co., Ltd.
Marshall, H. P., & Co., Ltd.
Phillips, J. W. & C. J.
Thwaites Bros., Ltd.

Loam and Sand Mills.
Davies, T., & Son.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Ward, T. W., Ltd.

Melting Furnaces (Oil-fired).
Alldays & Onions Pneumatic Eng. Co., Ltd.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Microscopes.
Swift, James & Son.

Mould Driers.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.

Moulding Machines.
Bush, Henry C.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P., & Co.
Phillips, J. W. & C. J.
Pneumatic Engineering Appliances Co., Ltd.
Samuelson & Co., Ltd.
Simplex Coke Oven and Eng. Co., Ltd.
Whittaker, Wm., & Sons, Ltd.

Moulding Machines (Hand and Power).
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Simplex Coke Oven and Eng. Co., Ltd.

Pig Breakers.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Simplex Coke Oven and Eng. Co., Ltd.
Sonnenthal, Selig, & Co.

Pig-Iron.
Bradley & Sons, T. & I., Ltd.
Frodair Iron and Steel Co., Ltd., The

Plumbago.
Bush, Henry C.
Cumming, Wm. & Co., Ltd
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.

Plumbago—*cont.*
Olsen, Wm.
Walker, I. & I.
Wilkinson & Co., Thos., Ltd.

Pneumatic Tools.
Jackman, J. W., & Co., Ltd.
Marshall, H. P. & Co.
Pneumatic Engineering Appliances Co., Ltd.
Simplex Coke Oven & By-products Co.

Polishing Sundries.
London Emery Works Co.

Publications.
Eagland & Co., Ltd.
Griffin, Charles & Co., Ltd.

Pyrometers.
Alldays & Onions
Phillips, J. W. & C. J.

Recording Gauges.
Evans, J. & Co.
Jackman, J. W., & Co., Ltd.
Phillips, J. W. & C. J.

Riddles.
Bush, H. C.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.
Simplex Coke Oven and Engineering Co., Ltd.
Wilkinson, Thos. & Co., Ltd.

Sand Blast Apparatus.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Tilghman's Patent Sand Blast Co., Ltd.

Sand Driers.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Phillips, J. W. & C. J.
Simplex Coke Oven and Eng. Co., Ltd.

Sand Grinding Mills.
Evans, J., & Co.
Jackman, J. W. & Co., Ltd.
London Emery Works Co.

Sand Mixers.
Evans, J., & Co.
Halls Eng. Co.
Jackman, J. W. & Co., Ltd.
London Emery Works Co.
Marshall & Co., Horace P.
Phillips, J. W. & C. J.
Simplex Coke Oven and Eng. Co., Ltd.

Sand Riddling, Separating and Sifting Machines.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
London Emery Works Co.
Marshall, H. P. & Co., Ltd.
Pneumatic Engineering Appliances Co., Ltd.
Simplex Coke Oven and Eng. Co., Ltd.
Sonnenthal, Selig & Co.

Sieves.
Durrans, J. & Sons.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Marshall & Co., Horace P.
Simplex Coke Oven and Eng. Co., Ltd.

Smiths' Hearths.
Alldays & Onions Pneumatic Eng. Co., Ltd.
Marshall & Co., H. P., Ltd.
Samuelson & Co., Ltd.
Sonnenthal, Selig, & Co.
Thwaites Bros., Ltd.

Steel Moulders' Composition.
Dyson, J. & J.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Lowood, J. Grayson, & Co., Ltd

Spades and Shovels.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Olsen, Wm.

Stone Flux.
Durrans, J., & Sons.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Wilkinson & Co., Thos., Ltd.

Stoppers and Nozzles.
Dyson, J. & J.

Straw Ropes.
Bowes, Proctor, & Co., Ltd.
Evans, J., & Co.
Hall, Charles, & Co.
Jackman, J. W., & Co., Ltd.
Olsen, William.
Wilkinson & Co., Thos., Ltd.

Testing Machines.
Evans, J., & Co.
Jackman, J. W., & Co., Ltd.
Marshall, H. P., & Co.
Phillips, J. W. & C. J.

Tuyeres (Firebrick).
Dyson, J. & J. [Ltd.
Lowood, J. Grayson, & Co.,

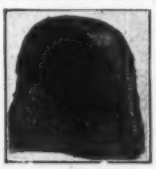
Welding. Thermit, Ltd.

A FRODAIR MIXTURE

is not a ready-made mixture of different irons, nor an alloy, but a formula for the mixture of certain brands of pig. Such a formula may be composed of Frodair brands of pig-iron only, or of one or more Frodair brands along with ordinary pig-iron or scrap or both.

Further details from—

THE FRODAIR IRON & STEEL Co., Ltd., Fenchurch House, London, E.C.



FOR

IRONFOUNDERS' BLACKING, COAL DUST, ETC.

Registered **"SHALAGO"** Brand.

Write for Quotations to—

WILLIAM CUMMING & Co., LTD.,

IRONFOUNDERS' FURNISHERS.

WORKS— { Kelvinvale, Mills, Maryhill, Glasgow.
Whittington Blacking Mills, Chesterfield, Eng
Sunnyside Blacking Mills, Falkirk, N.B.

TELEGRAPHIC ADDRESSES— { "Prudence, Glasgow."
"Cumming, Whittington, Chesterfield."
"Cumming, Blacking Mills, Camelon."

SITUATIONS VACANT AND WANTED.

FOREMAN MOULDER and FOUNDRY CHEMIST, 35, seeks engagement. Experienced in Tool, Engine, Electrical, Jobbing and Repetition, Machine and Plate Moulding. Well up in modern Cupolas and Air Furnaces. Chemical analyses a speciality. Strict disciplinarian. First-class references.—Address Box 244, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London W.C.

ADVERTISER, smart business; 20 years' experience; Foundry Equipment, calling regularly Foundries; big Scotch connection; open adopt Agency terms, or sole representation for Scotland; good references.—Box 20, THURMAN'S ADVERTISING AGENCY, 55, Howard Street, Glasgow.

FIREBRICKS & SILICA BRICKS. — Influential Foreign and Colonial AGENTS Wanted for high-class Material.—Apply Box 506, Offices of THE FOUNDRY TRADE JOURNAL, 165, Strand, London, W.C.

CARNEGIE RESEARCH SCHOLARSHIPS.

THE Council of the Iron and Steel Institute will shortly proceed to award Research Scholarships, founded by Mr. Andrew Carnegie.

Candidates, who must be under 35 years of age, must apply, before February 28th, on special forms, to be obtained from G. C. LLOYD, Secretary, Iron and Steel Institute, 28, Victoria Street, London, S.W.

FOR SALE AND WANTED.

PATTERN-MAKING.—All kinds of PATTERNS, large or small, made to customers' designs, by experienced workmen; accuracy and prompt delivery guaranteed.—LAMBERT BROS., Engineers, Snodland.

Just Published in Crown 8vo. Handsome Cloth. **1s. 6d.** net.

BLAST FURNACE PRACTICE.

By J. JAMES MORGAN, F.C.S., M.S.C.I.

CONTENTS.—Requirements.—Iron Ores.—Fuel.—Flux.—Slags.—Quantity of Slag.—Burden Charge, Round.—The Blast.—Ore Mixing.—Amount and Composition of the Iron.—Calculation of Flux.—Heating the Blast; Stove.—Drying, Changing, and Cleaning.—Drying the Furnace.—Filling the Furnace, and Lighting.—Charging the Furnace.—Descent of the Charge.—Flushing.—Tapping.—Hard Tapping Hole.—Running down the Beds (Casting).—Judging the Temperature. Controlling the Temperature.—Temperature and the Reduction of Silicon.—The Pig Iron.—Fuel Consumption.—Economy in Fuel Consumption.—Tuyeres: Leaky, Changing.—"Coolers" or "Jumbo."—Obstructions.—Pillaring.—Breakouts.—Hot Spots.—Scaffolds (Hanging).—Slips.—Damping Down.—Blowing Out.—INDEX.

By the same Author in Large 8vo. Handsome Cloth. Price **4s.**

QUANTITATIVE METALLURGICAL ANALYSIS.

TABLES for LABORATORY USE on the principle of "Group" Separations. "The Author may be CONGRATULATED on the way his work has been carried out."—*The Engineer.*

LONDON: CHAS. GRIFFIN & Co., Ltd., Exeter Street, Strand.

CORE ROPINGS,

Straw Ropes and Wood Wool Ropes, from ¼ in. to 2 in. Largest Stock.

— CRUCIBLES, —

Core Gum, Plumbago, &c. Cheapest and Best.

STEEL WIRE BRUSHES

For all purposes.

Carriage Paid quotations on application.

WILLIAM OLSEN, 74, Cogan St., HULL.

FOR SALE AND WANTED.

(Continued.)

MESSRS. C. A. ROBINSON & CO., Anchor Iron Wharf, East Greenwich, S.E., are Cash Buyers of every description of Scrap Iron and Steel, Brass, Copper, and all Metallic Residues. Telephone, 94 Deptford.

THE "ECLIPSE" SAND MIXER and GRINDER is the best for utilising Old Sand, Core Sands, Loam, and other Materials, mixed and prepared at lowest cost.—Apply HALL'S ENGINEERING Co., Hounds Gate Buildings, Nottingham.

TO IRONFOUNDERS, ENGINEERS, AND OTHERS.

OLD-ESTABLISHED BUILDER'S AND GENERAL IRONFOUNDER'S BUSINESS for DISPOSAL as a GOING CONCERN, carried on for many years in well-situated commodious Works, with Canal frontage, and close to railway goods depot, comprising extensive well-lighted Foundry (capacity 30 tons weekly, with 6 and 3-ton Travelling Cranes), Dressing, Fitting, Smiths' and Pattern Shops, Offices, and large open Yard, with Stabling and wide gateway entrances. The Modern PLANT and MACHINERY, including Tangye's 24-h.p. Gas Engine and Suction Gas Plant, Cupolas, Blowers, Foundry Boxes, and Tools. Valuable STANDARD PATTERNS and STOCK-IN-TRADE at valuation.

A Lease of the Works can be had at a moderate rent.

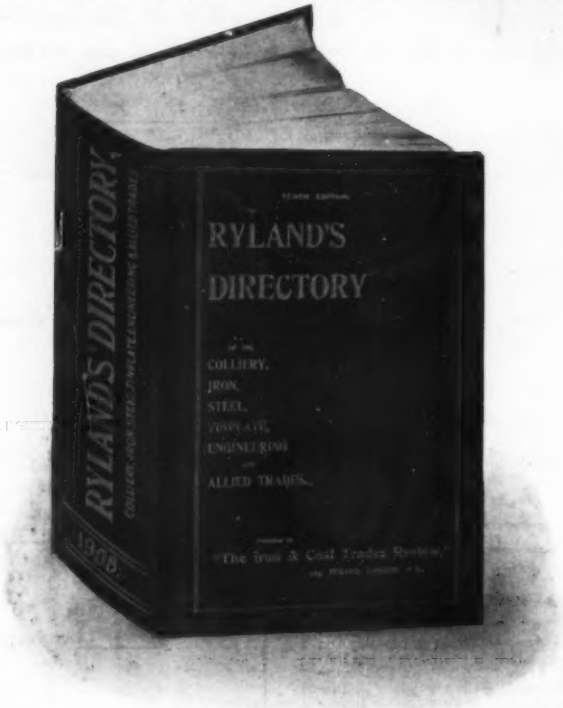
For further particulars apply EDWARDS, SON & BIGWOOD, Auctioneers and Valuers, 17 and 19, Colmore Row, Birmingham, and 94, High Street, Bromsgrove.

38½"
McNEIL'S
PATENT UNBREAKABLE
STEEL LADLES
These Ladles are manufactured by a patented process, each from a single steel plate without weld or rivet. They are extremely light, being at the same time the strongest and most durable in the market. Ladles to contain 56 lb. of metal only weigh about 7 lb. each. They are made of all capacities from 30 lb. to 60 cwt., with or without lips; also mounted or unmounted. They are also suitable for chemical or metallurgical processes. List of sections and prices on application to
CHAS. McNEIL.
KINNING PARK IRONWORKS, GLASGOW.
36"
32½"

Can also be made in Aluminium.

IMPORTANT NOTICE.

We are sorry and glad to inform our clients that



is out of print, sorry because we are bound to disappoint somebody, glad because of the increasing demand for this useful publication. We are in consequence of the above, making earlier arrangements and will produce RYLAND'S DIRECTORY, 1910, in April.

Advertisers please note that we have important advt. space to let and can now give special positions.

RATES FOR ADVERTISEMENTS.

Coloured insets opposite any selected vacant position ... £10 per page.
Ordinary advertisements ... ... £6 " "
The above prices include one copy (cloth) of the Directory.

EAGLAND & Co., Ltd., Publishers.

165, Strand, London, W.C.

Telegrams: "Zacatecas, London." Telephone: 2346 Gerrard.

Index to Advertisers.

Addresses, Telegraphic Addresses, and Telephone Numbers.

PAGE NO.	NAME.	DESCRIPTION.	ADDRESS.	TELEGRAPHIC ADDRESS.	TELEPHONE NO.
—	Alldays & Onions, Ltd....	Foundry Plant	Birmingham	Alldays, Birmingham...	328 Victoria
C. ii.	Bradley, T. & I., & Sons, Ltd. ...	Pig-Iron	Darlaston	—	—
C. iii.	Buffalo Forge Co.	Fans and Blowers	Caxton House, London	Buffaloes, London ...	Victoria 420.
61	Bush, Henry C.	Foundry Specialists ...	The Strand, Derby	Bushes, Derby	Nat. Tel. 143 & 387.
110	Cumming, William, & Co., Ltd. ...	Blacking Manufacturers ...	Maryhill, Glasgow	Prudence, Glasgow ...	P.O. M. 25
59	Davies, T., & Sons	Cupolas...	West Gorton, Manchester... ...	Tuyere, Manchester ...	70 Openshaw
107	Durrants, Jas., & Sons	Foundry Equipment	Penistone, nr. Sheffield	Durrans, Penistone ...	—
58	Dyson, J. & J.	Ground Gannister	Sheffield	Dyson's, Stannington...	702 Sheffield
105	Elders' Navigation Collieries Ltd. ...	Foundry Coke	Cardiff	Elder, Maesteg	10
64-103	Evans, J., & Co.	Foundry Requisites... ...	Manchester	Ladles, Manchester ...	2297
110	Frodair Iron & Steel Co., Ltd. ...	Pig-Iron	5, Fenchurch Street, E.C.... ...	Frodair, London ...	—
60	Goldendale Iron Co., Ltd.	Pig Iron	Tunstall, Stoke-on-Trent	—	—
111	Griffin, Chas., & Co., Ltd.	Publications	Exeter Street, Strand, W.C. ...	—	—
62	Hall, Charles & Co.	Foundry Requisites... ...	Dantzic Street, Manchester ...	—	—
57	Harris & Pearson...	Cupola Linings	Stourbridge	Fireclay, Stourbridge...	7 Brierley Hill
58	Hislop, R. & G.	Gas Engineers	Paisley	Gas, Paisley	321 Paisley
C. iv.	Jackman, J. W., & Co.	Foundry Requisites... ...	Caxton House, S.W.	Molders, London ...	30 Victoria
—	Jenkins, W. J., & Co.	Gas Cleaning Fans	Retford	—	—
111	King, Bros.	Cupola Bricks	Stourbridge	—	—
108	London Emery Works Co., Ltd. ...	Foundry Requisites... ...	Park, Tottenham	Naxium, London ...	99 Tottenham
48	Lowood, J. Grayson, & Co., Ltd. ...	Ganister, Cupola Blocks, &c.	Deepcar, nr. Sheffield	Lowood, nr. Sheffield	18 Stocksbridge
5	Marshall, H. P., & Co.	Core Machines	Leeds	Specialty, Leeds ...	1909 Leeds
111	McNeil, Chas.	Steel Ladles	Kinning Park, Glasgow	McNeil, Glasgow ...	X 155
111	Olsen, William	Plumbago and Blacking ...	Cogan Street, Hull	—	—
62	Phillips, Chas. D.	Foundry Core Ovens ...	Newport, Monmouthshire ...	Machinery, Newport ...	18 & P.O. 576
62	Phillips, J. W. & C. J.	Foundry Requisites... ...	23, College Hill, E.C.	Colloquial, London ...	10122 Central
C. iii.	Plasti-Kion Co., The	Iron Cement	Caxton House, S.W.	—	—
106	Pneumatic Eng. Appliances Co., Ltd.	Pneumatic Appliances ...	Palace Chambers, Westmntr. S.W.	Pneumogram, London...	856P.O.Victoria
112	Samuelson & Co., Ltd.	Blowers	Banbury	Samuelson, Banbury ...	—
104	Selson Eng. Co., Ltd.	Core-making Machines ...	85, Queen Victoria Street, E.C. ...	Selig, London	341 Bank
—	Silent Machine & Engineering Co. ...	Foundry Cement	2, Savile Street, Sheffield... ...	Forward, Sheffield ...	189, 1472, &c.
—	Silica Firebrick Co.	Ground Ganister	Oughtibridge	Silica Co., Oughtibridge	—
62	Stonehouse Works Co.	Wood, Wool, Core Ropes ...	King Edward's Rd., Birmingham	Tailboard, Birmingham	3069 Cl. (3 lines)
105	Thermit, Ltd.	Welding	27, Martin's Lane, E.C.	Fulmen, London ...	3719 Central
C. ii	Tilghman's Patent Sand Blast Co., Ltd.	Sand Blast Apparatus ...	Broadheath, nr. Manchester ...	Tilghmans, Altrincham	14
63	Thwaites Bros., Ltd.	Foundry Plant	Bradford	Thwaites, Bradford ...	325 Bradford
61	Vaughan & Sons, Ltd.	Cranes	West Gorton, Manchester ...	—	—
C. ii.	Walker, I. & I.	Foundry Blackings	Rotherham	—	—
—	Ward, T. W., Ltd.	Cupolas, Loam Mills, &c. ...	Albion Works, Sheffield	Forward, Sheffield ...	189, 1472, &c.
58	Whittaker, W., & Sons, Ltd.	Moulding Machines... ...	Oldham	—	—
61	Wilkinson, Thos., & Co., Ltd. ...	Foundry Requisites... ...	Middlesbrough	Blacking. Middlesbro	419

STOURBRIDGE FIRE BRICKS

Of Best Quality for Lining Cupolas in Stock,

ALSO MADE TO ANY DESIGN.

Linings Stocked to Customers' Plans to ensure IMMEDIATE DELIVERY.

All kinds of Fireclay Goods of Highest Quality.

HARRIS & PEARSON, STOURBRIDGE.

Telegrams:—"FIRECLAY, STOURBRIDGE." **Telephone:—No. 7 Brierley Hill.**

Sole Makers of "PEHRSON'S PATENT STEEL MOULDERS' GREENSAND."

GROUND GANNISTER, STEEL MOULDERS' COMPOSITIONS, SILICA CEMENT.

Gannister Bricks, Fire Bricks, Stoppers and Nozzles. Crucible Clay for all Purposes.

J. & J. DYSON, SHEFFIELD GANNISTER WORKS, ATTERCLIFFE ROAD, SHEFFIELD.

Telegrams—"DYSON'S, STANNINGTON." Telephone—No. 702 SHEFFIELD.

EFFICIENT AND ECONOMICAL HEATING OF FOUNDRY STOVES, . . . ANNEALING OVENS, FURNACES, &c. . . . .

R. & G. HISLOP,

Gas Engineers, Underwood House, PAISLEY.

WHITTAKER'S IMPROVED MOULDING MACHINE

By which Wheels or Pulleys of any description or size from 3 inches to upwards of 20 ft. diameter can be made.

The most complete and efficient machine hitherto introduced to Engineers.

All Machines warranted to Mould with the greatest accuracy and precision.

GEARING WHEELS

Spur or Bevel, Straight Teeth and Double Helical Teeth Supplied to Consumers.

ROPE & BELT PULLEYS.

WM. WHITTAKER & SONS, LTD.,

SUN IRON WORKS, OLDHAM.

T. DAVIES & SON,

RAILWAY IRON WORKS, WEST GORTON, MANCHESTER.

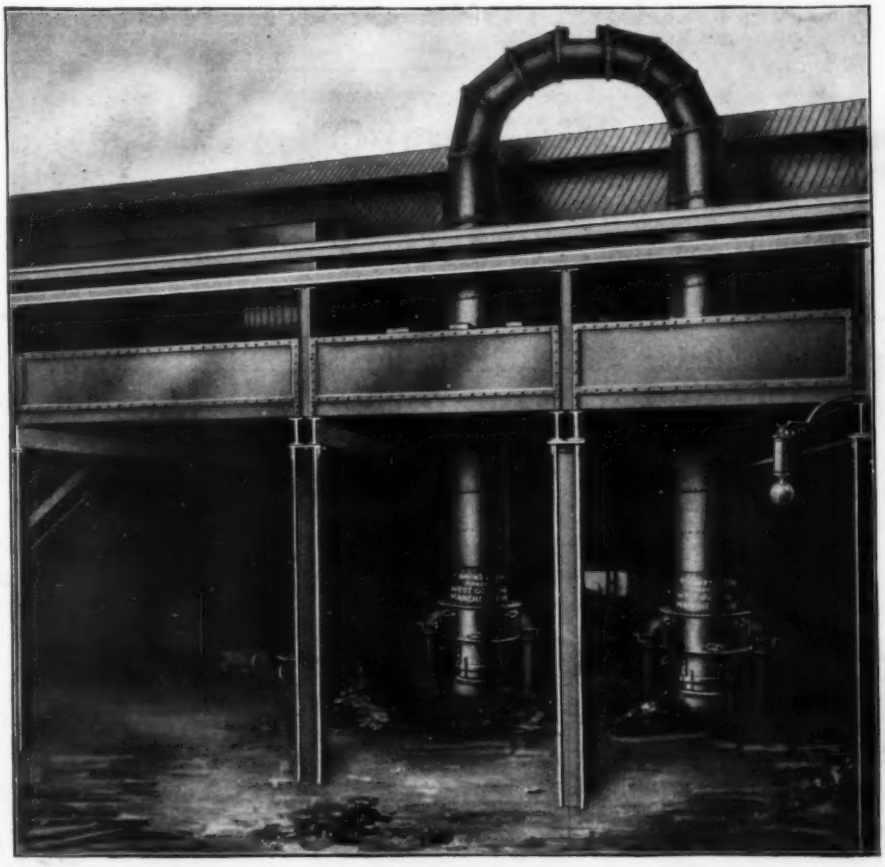
ON ADMIRALTY LIST.

Telegrams—"TUYERE, MANCHESTER." Nat. Telephone—No. 70, OPENSHAW.

MAKERS OF

FOUNDRY CUPOLAS & LADLES.

CHARGING PLATFORMS, HOISTS, FOUNDRY RATTLERS,
CORE STOVE DOORS, ROOTS' BLOWERS. . . . .



OSBORN'S PATENT SPARK ARRESTER FITTED TO TWO CUPOLAS.

STANDARD SIZES IN STOCK OR PROGRESS.

LICENSEES AND MAKERS OF

Osborn's Patent Spark Arrester.

GOLDENDALE CYLINDER PIG IRON.

Makers: **GOLDENDALE IRON CO.,**

TUNSTALL, STOKE-ON-TRENT. (Established 1844.)

Hard, Close Grey Pig-Iron.

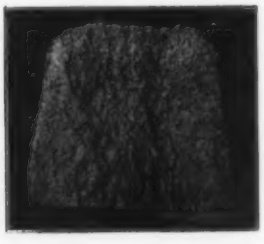
Exceedingly Fluid when Melted and Easy to Machine.

UNRIVALLED for SOUNDNESS and GOOD WORKING PROPERTIES.

Specially Suitable for HIGH-CLASS GAS, STEAM, and HYDRAULIC CYLINDER CASTINGS.

MAKERS of a Special Quality for **MOTOR CYLINDERS.**

Contractors to the ADMIRALTY, Principal RAILWAY COMPANIES, and GOVERNMENT CONTRACTORS.



Agents for Lancashire and Districts:—

WESTOBY & RAWSTRON, 331, CORN EXCHANGE BUILDINGS, MANCHESTER.

FOUNDRY REQUISITES of Every Description

In Stock for Prompt Delivery.

PIG IRON, FOUNDRY COKE, GANISTER, LIMESTONE, SAND, ETC.

Also Manufacturer of WOOD WOOL CORE ROPE

Which is far superior to Straw Rope, and other similar material on the market. Sizes ½ in. to 2 in. diameter in stock.

Prices and Samples on Application.

HENRY C. BUSH. COMPLETE FOUNDRY SUPPLIER, DERBY.

Tel: 143 & 387. Tele: Bushes, Derby.

VAUGHAN'S OVERHEAD RUNWAY

REDUCES LABOUR and INCREASES OUTPUT.

INDISPENSABLE FOR CONVEYING

MOULDING BOXES.
HOT METAL.
CASTINGS.
PATTERNS.
CORES.
SCRAP.
LOAM, Etc.

SEND FOR PARTICULARS TO—

VAUGHAN & SON, Ltd. Runway and Light Crane Dept., WEST CORTON-W., MANCHESTER.

ON ADMIRALTY, WAR OFFICE, and INDIA OFFICE LISTS.

"CARLTON" PATENT BLACKING

may not be the cheapest but it is the BEST and ONLY reliable "ALL ROUND" Blacking on the market. It is extensively used in Great Britain and Colonies for Flat and Round Stove and Range Work, Baths, Furnace Pots, Jobbing Work up to 40 tons, Light and Heavy Engineering Castings, Ingot Moulds, &c., &c.

Send for Free Trial Sample and Price.

THOMAS WILKINSON & CO., LTD., FOUNDRY STORES, MIDDLESBROUGH.

CHARLES D. PHILLIPS'

THE ORIGINAL FIRM.
— Established 1867. —

Registered and Improved No. 356,812

FOUNDRY CORE OVEN

(Self-contained).

Head Office—
EMLYN WORKS, NEWPORT, MON.
(And Gloucester).
ESTABLISHED 42 YEARS.

CHAS. HALL & CO.,

FOUNDRY REQUISITE MAKER,

DANTZIC ST., MANCHESTER.
TELEPHONE No. 5814, CITY.

STEEL WIRE BRUSHES.

Chaplets and Studs a Speciality.

WOOD WOOL CORE ROPES,

WE ARE

ACTUAL MANUFACTURERS (NOT FACTORS),

Of all Sizes ¼ to 2¾.

BUY DIRECT. DON'T BE MISLED.

Buying per 1000 yards, you cannot measure it. . . . Buy by guaranteed weight.

FROM STONEHOUSE WORKS, CO., KING EDWARD'S ROAD, BIRMINGHAM.

TELEPHONE: No. 3069, "CENTRAL 3-LINES." WORKS: "PERRY BAR." TELEPHONE: 237 EAST. TELEGRAMS: "TAILBOARD, BIRMINGHAM."

WE PUBLISH THE MOST COMPLETE CATALOGUE OF

MODERN FOUNDRY EQUIPMENT.

For 27 years our name has been a guarantee of quality.

WRITE FOR NEW LISTS SINCE PUBLISHED.

Rockwell Lift-out and Tilting Crucible Furnaces.
„ Simplex Melting Furnaces (Oil Fired).
Sand Mixing Machines. Coke Breakers.
Small Cupolas.
Ash Crushing and Washing Machines.
Bristol Indicating, Switchboard, Portable and Recording Electric Pyrometers for Blast Furnaces, Steel Works, Molten Metal, Hardening, Annealing, Testing, etc.

J. W. & C. J. PHILLIPS,

23, COLLEGE HILL, CANNON STREET, **LONDON, E.C.**

Contractors to the War Office, Admiralty, India Office, Crown Agents for the Colonies, British and Foreign Railway Companies.

FOUNDRY PLANT.

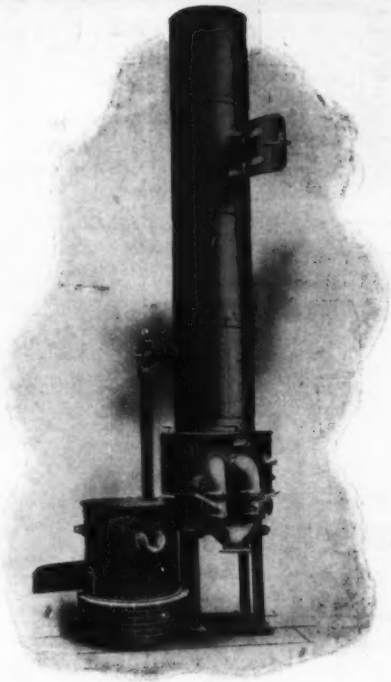
"Rapid" Cupolas,

with or without receivers or drop bottoms.

Roots' Blowers,

belt, steam-engine, or electro-motor driven.

Charging Platforms, Hoists, and Ladles.



ECONOMICAL RESULTS GUARANTEED.

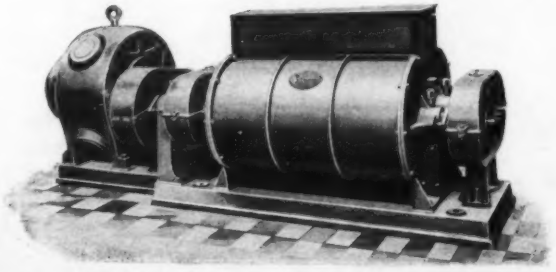
We are also Manufacturers of Steam Hammers, Smiths' Hearths, Centrifugal Pumps and Fans, High-Speed Engines, and the "Bradford" Patent Boiler Feed Pump.

We are the original makers of "Rapid" Cupolas as under Stewart's Patent. We make this intimation as other makers are introducing this description, which had become established as a synonym of Stewart's Cupolas.

CONTRACTORS TO HIS MAJESTY'S GOVERNMENT.

THWAITES BROS., LTD.,

Vulcan Ironworks, BRADFORD.

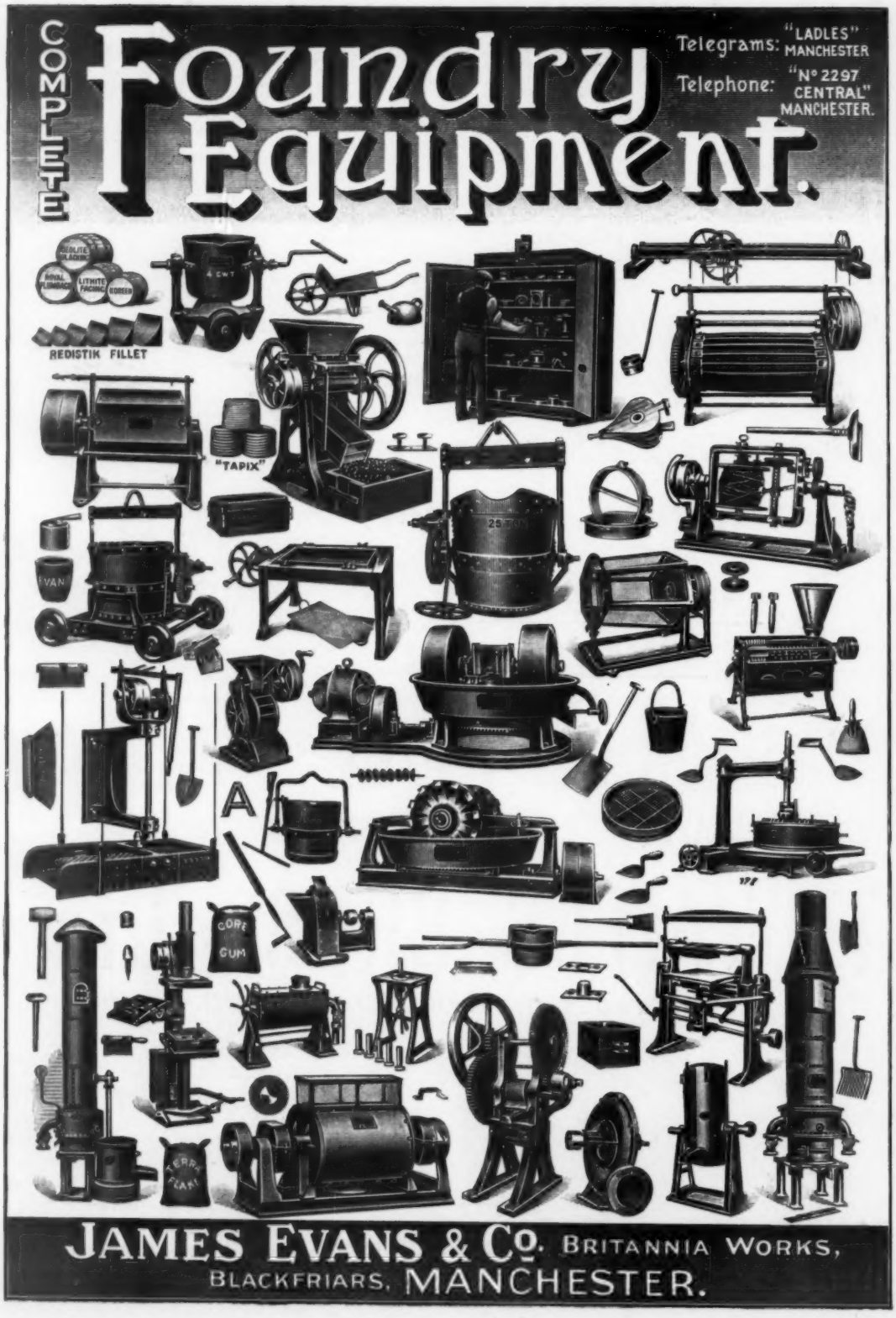


Telegrams—
"THWAITES, BRADFORD."

Telephone—
No. 325 BRADFORD.

London Office:
96 & 98, Leadenhall Street, E.C.

Catalogues on Application.


COMPLETE
Foundry Equipment.
Telegrams: "LADLES" MANCHESTER
Telephone: "N° 2297 CENTRAL" MANCHESTER.
REDISTIK FILLET
"TAPIX"
JAMES EVANS & Co. BRITANNIA WORKS,
BLACKFRIARS, MANCHESTER.